NIST/NOAA National Marine Analytical Quality Assurance Program

Description and Results of the 2003 Interlaboratory Comparison Exercise for the Determination of Trace Elements in Marine Mammals

DRAFT REPORT

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INTRODUCTION

It is important to underpin the accuracy of laboratories that perform marine environmental analyses. The ability to accurately determine trace elements in a wide range of marine sample types is required to assess their impact on human and animal health and nutrition, provide temporal "snapshots" of marine environmental quality and to identify global, regional and point sources that release contaminants into the atmosphere and coastal ecosystem. Critical reference standards are often not available for this niche analytical community. This limitation can lead to decisions based on subjective analytical results that can have significant economic and health consequences. NIST helps benchmark and improve the quality of analytical data gathered on the marine environment by administering annual interlaboratory comparison exercises through several programs, including the National Marine Analytical Quality Assurance Program (NMAQAP), which is supported by the NOAA/NMFS Marine Mammal Health and Stranding Response Program. Part of NIST's duties under the NMAQAP include the production of quality control and reference materials that are distributed in annual interlaboratory comparison exercises, organization and coordination of the QA exercises, performing baseline analytical measurements on marine samples collected and stored in the NIST National Biomonitoring Specimen Bank and analytical method development. The diversity of the twenty-four participating institutions represented in this year's exercise suggest that the Interlaboratory Comparison Exercise for the Determination of Trace Elements in Marine Mammals extends beyond the scope of the NMAQAP to the analytical community as a whole, including academic institutions, contract laboratories, international laboratories and government agencies. This year (2003) marks the third iteration of the exercise. Participants were asked to perform measurements for a suite of 12 analytes (As, Cd, Cu, Fe, Hg, Mn, Mo, Rb, Se, Sn, V and Zn) in two QA materials: Beluga Whale Liver Homogenate, QC97LH2 and Pygmy Sperm Whale Liver Homogenate, QC03LH3. This report summarizes the key results of the exercise and the statistical tools used for data evaluation. Consensus data was generated using the Rukhin-Vangel maximum likelihood estimation model [1], which uses weighted means statistics and considers both within and between laboratory variances. International Union of Applied Chemistry (IUPAC) guidelines are implemented to evaluate laboratory performance through the use of z-and p-scores, which provide a mechanism to assess the comparability of data produced by the participating laboratories. Finally, laboratory biases are also evaluated graphically through the use of Youden plots.

EXPERIMENTAL

Test Materials

Beluga Whale (Delphinapterus leucas) Liver Homogenate (QC97LH2) – used as a control standard in the QA exercise

Pygmy Sperm Whale (Kogia breviceps) Liver Homogenate (QC03LH3) – used as an unknown in the QA exercise

Materials Used in the Exercise

Two whale liver homogenate materials were issued to the participating laboratories. QC97LH2 was developed from liver tissue collected from Beluga whales taken in Alaska native subsistence hunts in 1996 at Point Lay, Alaska. This material served as the control for the exercise. QC03LH3 was developed from a single live-stranded animal found at station 26, Sullivans Island, Charleston County, SC on August 10, 1994. Wayne McFee (NOS/CCEHBR), NMFS and SCDNR personnel coordinated transport of the animal to the SCDNR Marine Resources facilities where the animal was placed in a 12' circular holding tank and monitored for five days. The animal died on August 14, 1994, was necropsied and samples were provided to NIST through the vehicle of the National Marine Mammal Tissue Bank. All of the tissues were cryogenically pulverized and homogenized under clean room conditions to provide fresh-frozen, powder-like materials.

Exercise Requirements and Target Analytes

The twenty-four participating institutions (listed in Appendix A) were each sent ~ 8-10 grams of each of the above materials in frozen jars using liquid nitrogen (LN2) vapor or dry ice shippers. Typically, the LN2 shippers were used for overseas shipments and the dry ice shippers were used for domestic shipments. Each laboratory submitted data in spreadsheet format via email. Originally, there were more than twenty-four participating laboratories. Materials were sent to several domestic and international institutions but no data was returned to NIST, and the biological samples could not clear customs for Spain.

The following requirements were stipulated to the participants:

1. Analyze samples for elements (As, Cd, Cu, Fe, Hg, Mn, Mo, Rb, Se, Sn, V and Zn) using accepted analytical procedures.

2. Digest, process, and analyze three aliquots of QC97LH2

3. Digest, process, and analyze five aliquots of QC03LH3

RESULTS AND DISCUSSION

Establishment of Consensus Values

Outliers

First, the competency of each laboratory was evaluated by comparing the results for the QC97LH2 control sample against NIST-established data that was collected using two independent analytical techniques, instrumental neutron activation analysis (INAA) [2] and inductively coupled plasma mass spectrometry. These measurements provide a good estimate of the concentration and uncertainty for each element in the QC97LH2 sample, as jar-to-jar sample heterogeneity is incorporated into the uncertainty estimates and method accuracy was verified with concurrent analyses of NIST Standard Reference Materials. Each laboratory was asked to analyze n = 3 subsamples of QC97LH2. A laboratory was arbitrarily defined as an outlier for a particular element if the difference between the reported mean for the participating laboratory and the mean of the NIST data differed by 20 % or greater. Furthermore, a laboratory that was determined to be an outlier for an element in the QC97LH2 sample was automatically considered an outlier for the identical element in the unknown sample, QC03LH3, regardless of the degree of agreement between the reported value and the consensus mean value. Outlier data were not used in the determination of the consensus means for elements in the unknown samples, however data were treated the same statistically, in terms of computing summary statistics and z- and p-scores. Outlier data was represented graphically provided it did not severely distort the raw data plots and consensus mean plots. The results of the outlier tests for each laboratory as a function of element for the QC97LH2 sample are given in Appendix B, Table 1. This gross outlier rejection protocol worked well to *a priori* identify laboratories that would distort the consensus mean. In a minority of instances, a second level of outlier rejection was necessary and based on the exercise coordinator's judgement.

Consensus Means

There are many approaches used at NIST to compute an estimate of a consensus mean and its associated uncertainty, based on a dataset from multiple laboratories and multiple methods. The consensus means determined in this exercise are based on the weighed mean of the individual laboratory means using a maximum likelihood solution model. When choosing a model to estimate a consensus mean, several fundamental factors must be considered. For any given analyte, the number of individual measurements may vary across the laboratory and moreover, the within laboratory variances can differ across the laboratories. The number of laboratories will also influence the choice of method used to estimate the consensus mean. These factors will determine how to appropriately weight each laboratory, or whether to treat all laboratories equally. The plot in Fig. 1 will help to illustrate this point. Figure 1 is a homoscedasticity plot that was generated for Mn in the QC03LH3 material, employing data submitted by 24 laboratories. The vertical scatter in the plot is an indication that the variances across the laboratories are not equal, thus a consensus mean estimator model that is based on weighted means statistics may be more

applicable than a simple "mean of means" model, where the estimate is an equi-weighted mean with no regard to possible differences in within laboratory variation.

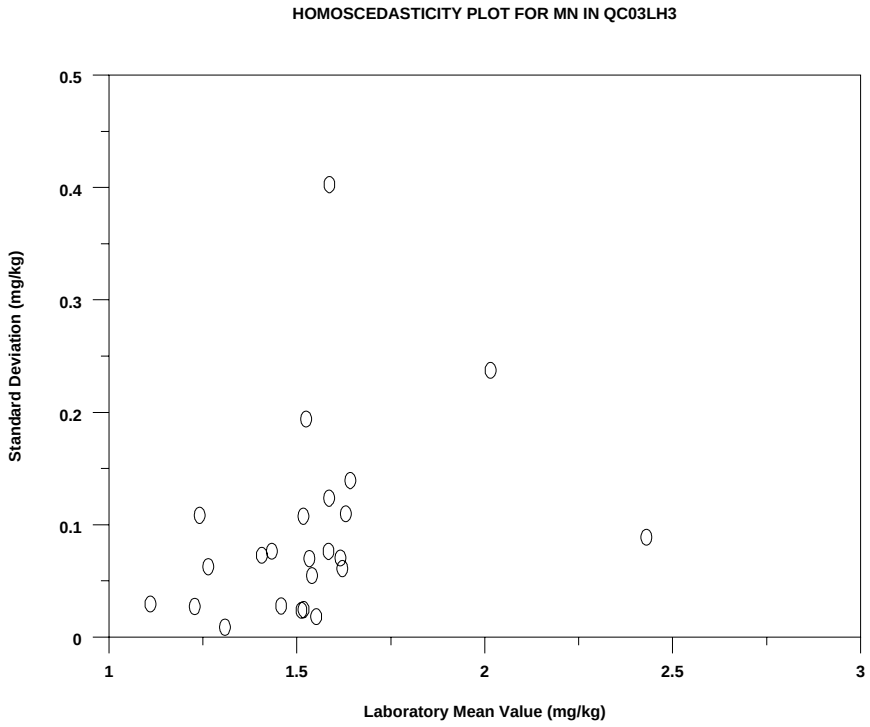

Figure 1. Homoscedasticity Plot for Mn in QC03LH3

Furthermore, consensus data is often used to "grade" each participating laboratory based on its proximity to the consensus value, e.g. using IUPAC guidelines (z- and p-scores) as in this exercise. Therefore it is desirable to incorporate an outlier rejection scheme and also provide a good estimate of the confidence interval about the consensus mean that, if possible, incorporates both within laboratory variances and between laboratory variance. This allows each participating laboratory to consider the merit of the consensus value as a point of reference.

The distribution of the analyte data always should always be considered as well, as most estimation models assume that the data will follow a normal distribution. Figure 2 gives example histograms and normal probability plots for the Mn raw data submitted for QC03LH3. The histogram and normal probability plot in Fig. 2a indicate graphically that this particular dataset is non-normally distributed. Applying a Shapiro-Wilk test to the data corroborates the visual indications, i.e., $p < 0.0001$ is lower than the 95% significance level for p (0.01) and non-normality can be assumed. The histogram and normal probability plot are regenerated in Fig. 2b after removing suspected outlier laboratories (concentration cut-off ~ 2 mg/kg, refer to Fig 1.). Here the results for the Shapiro-Wilk test yielded $p = 0.08$ and normality can be assumed.

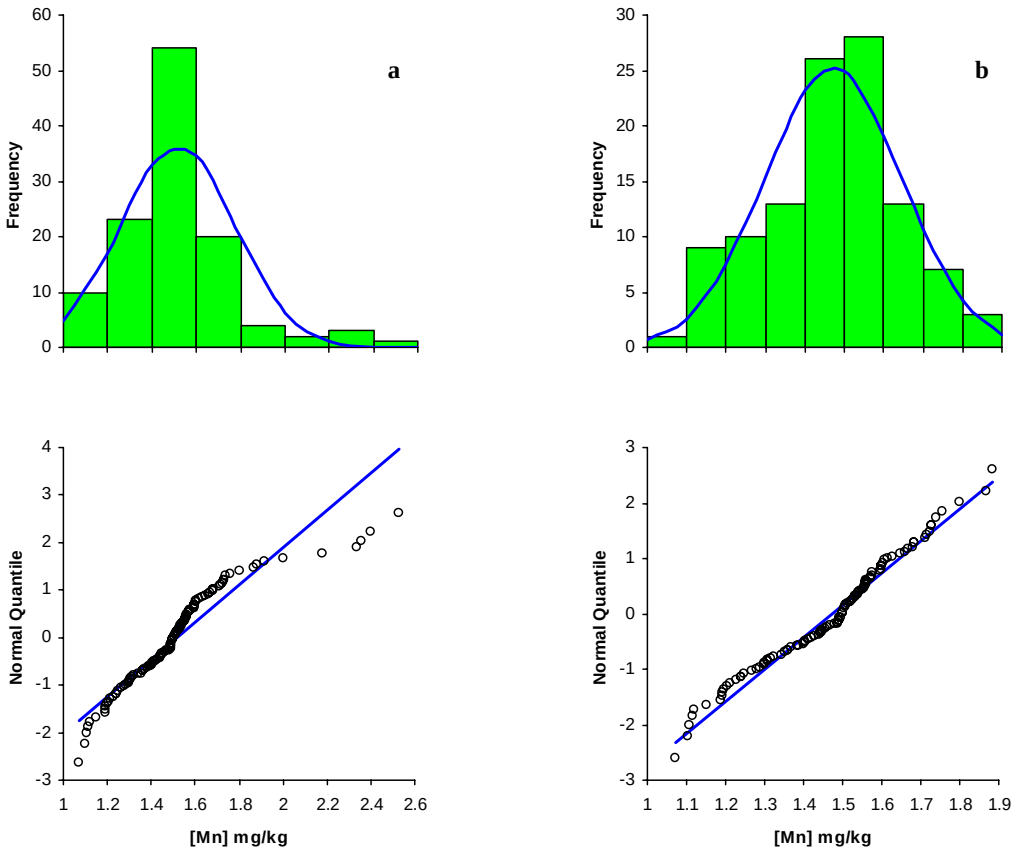

Figure 2. Histogram and Normal Probability Plot for Mn in QC03LH3 before (a) and after (b) removal of outliers

Thus the assumption of normality is applicable to the data in this exercise with the caveat that outlier data (if left unaccounted for) can easily negate the "normality" of a dataset. The model chosen for computing the consensus mean estimates includes an assumption of normality and helps to de-emphasize laboratory means that possess large variances.

The Rukhin-Vangel maximum likelihood model [1] used in this exercise addresses a number of the items discussed above. An overview of the statistical model follows to help the participating laboratories understand the procedures used to determine a maximum likelihood estimate of the consensus mean. The maximum likelihood solution used to estimate the consensus mean and its associated uncertainty is based on a one-way random effects ANOVA model that may be both unbalanced (i.e., the number of observations from each laboratory need not be equal) and heteroscedastic (i.e., the within laboratory variances can be unequal):

$$X(ij) = Xcon + L(i) + e(ij)$$

Where there are i = 1, …, p laboratories and j = 1, …, n(i) observations for each laboratory. In this model, Xcon is the consensus mean, L(i) is the lab effect and e(ij) is the error term. The L(i) are normally distributed as $N(0, \sigma^2)$ and the L(i) are normally distributed as $N(0, \sigma(i)^2)$. Here σ^2 and $\sigma(i)^2$ represent the between laboratory variance and within laboratory variances, respectively. The maximum likelihood equations are rather complicated in form and are not reproduced here. A copy of the Rukhin-Vangel paper [1] can be provided to interested participants as it presents this topic in a statistically rigorous fashion. Alternatively, a more simplistic discussion follows that is based on the Mandel-Paule procedure for estimating a consensus mean. Rukhin and Vangel show in [1] that the Mandel-Paule approach closely resembles that of the maximum likelihood procedures used to estimate consensus values.

The Mandel-Paule algorithm consists of using weights of the form:

$$w(i) = 1/(y + t(i)^2)$$

where y is an estimate of the between laboratory variance that is determined using an iterative process and $t(i)^2$ is the within laboratory variance of the mean (i.e., $s(i)^2/n(i)$), where $s(i)^2$ is the variance of the ith laboratory and n(i) is the corresponding number of observations. It is important to again make the distinction between the procedures used in this exercise and the more familiar "mean of means" procedure for calculating the consensus mean, where the latter approach necessarily weights each laboratory identically, regardless of its analytical repeatability. In this exercise the weight of a laboratory in the consensus mean is proportional to its accuracy measured as the inverse variance, and the weights assigned actually minimize the variance of the consensus mean. The weights are used in the estimator of the consensus mean as:

$$xcon = SUM\ (w(i)x(i))/SUM\ (w(i))$$

where x(i) is the reporting laboratory mean and the summation is from i = 1 to p where p is the number of laboratories. The between laboratory variance y is estimated by iteratively solving the following equation:

$$SUM\ ((x(i) - xcon)^2/(y + t(i)^2) = p-1$$

The standard error of the estimate of the consensus mean is then computed using the following formula:

$$((SUM\ ((x(i) - xcon)^2/(y + t(i)^2))^{0.5}/SUM(1/(y + t(i)^2)$$

where the summation is from i = 1 to p and p is the number of laboratories. Finally, this standard error is multiplied by a coverage factor to determine a confidence interval about the consensus mean, as given in equation (19) in the Rukhin-Vangel paper. The only drawback to this uncertainty estimate is that it is based on asymptotics (i.e., the number of laboratory sources going to infinity). This is of course a somewhat unrealistic assumption, so the maximum likelihood approach is reserved for cases when the number

of datasets (reporting laboratories) is greater than six, as is the case for all elements reported in this exercise.

Assignment of z- and p-scores

The z-score is a bias estimate calculated from the difference between the laboratory mean (x(i)) and the consensus mean (xcon) divided by a target value (σ_{target}) for standard deviation:

$$z = (x(i) - xcon) / \sigma_{target}$$

The choice of σ_{target} will be dependent on the data quality objectives of a particular quality assurance program. For this exercise, z-scores are calculated using a fixed fit for performance criterion (σ_{target}) of ± 10 % of the consensus mean. Using two examples, this performance criterion implies that respectively for z = ± 1 or z = ± 2, the result is 10 % or 20 % higher (or lower) than the consensus mean. One should use z-scores to comment on relative and not absolute concentration accuracy. With this caveat, z-scores can be classified into categories to assess the performance of each laboratory:

$|z| \leq 2$ Satisfactory

$2 \leq |z| \leq 3$ Questionable

$|z| \geq 3$ Unsatisfactory

Using a "fixed" performance criterion offers a way for each laboratory to compare their performance on different samples and against other participating laboratories. It should be recognized that any particular laboratory might have a detection limit or analytical method deficiency for a particular analyte. The acceptability of a particular laboratory's results should be judged in the context of the data quality needs and environmental ramifications of a particular program. The z-score results for the QC03LH3 samples are displayed in Appendix C within the consensus data tables. It should be expected that z-scores of greater than z = ± 1 will occur with greater frequency for decreasing analyte concentrations.

The external repeatability of each laboratory for individual elements is assessed using a p-score (precision score) where laboratory repeatability (i.e. the coefficient of variation) is normalized to an assigned target value for the coefficient of variation:

$$p = CV_{Lab}/CV_{Target}$$

Note that "p" in this context refers to the p-score and not the number of laboratories as presented in the discussion on consensus means using the maximum likelihood model. The value for CV_{Target} is fixed at 10 % for this interlaboratory comparison exercise.

Using two examples, this value for CV_{Target} implies that respectively for p = 0.5 or p = 1.2, the laboratory repeatability is 5 % or 12 %. The frequency of higher p-scores can be rationalized by referring back to the z-score discussion. One cannot ignore the fact that sample inhomogeneity may be a limiting factor when evaluating intralaboratory repeatability. In fact, comparing p-scores as a function of laboratory and element can help highlight within jar sample inhomogeneity and not necessarily poor laboratory performance.

Data Outputs

Raw data for QC97LH2 is included with the outlier test results in Table 1, Appendix B. Laboratory and Consensus mean results, summary statistics, maximum likelihood weights, tau estimates (the maximum likelihood estimates of within laboratory variance) and z- and p-scores are given in Appendix C for each element in the unknown material, QC03LH3. The maximum likelihood weights range from 0-1 with higher weights reflecting a larger influence on the determination of the consensus mean. Raw data plots showing the individual measurements for each laboratory and the corresponding consensus mean plots are shown directly across from the aforementioned tabulated data so that the reader can easily reference their results graphically.

Youden Plots

The Youden plot [3] is a classic graphical tool used to evaluate laboratory bias when each laboratory has collected data on two similar materials. The Youden plot offers a simple but effective means for comparing between- and within-laboratory variability, and highlighting possible outliers. The key question the Youden plot helps to answer is: Are the laboratories in the study behaving as if they are all from a single population? A Youden plot can be used to provide information on the occurrence of indeterminate (random) and determinate (systematic) errors, if the concentrations of the analytes are similar in the samples that comprise the plot. A Youden plot will exhibit a structureless "random shotgun pattern" about a point of reference [3], if all laboratories reside within a single population and indeterminate errors are occurring. Measurements appearing in the upper right and lower left quadrants of the Youden plot indicate, respectively, that a laboratory's measurements are consistently biased high or low relative to measurements performed in other laboratories. Sources of such determinate errors include calibration errors, blank correction errors, and analytical method errors such as analyte volatility (loss) and sample contamination. The Youden plots in Appendix D use the intersection of the NIST reference value for the control material (QC97LH2) and the maximum likelihood consensus mean value calculated for the unknown material (QC03LH3) as a relative point of reference (square marker, intersection coordinates x = 1, y = 1). This bias reference point represents the best estimation of the true values. A two-dimensional 95% confidence interval is cast about the point. Measurements from individual laboratories (circles) are normalized to the bias reference point described above so that they can all be compared against a common accuracy benchmark. In general, laboratories falling closer to the bias reference point demonstrate the ability to perform accurate measurements. Laboratories whose measurements consistently remain far away

from the bias reference point demonstrate either systematic bias (lower left and upper right quadrants) or other inconsistencies (measurements appearing in alternate upper left or lower right quadrants). Where possible, independent NIST measurements for QC03LH3 (triangles) are included on the Youden plots as a second point of reference.

Analyte Data and Scoring

Referring to the z-scores in the consensus data tables (Appendix C) shows that numerous subgroups of the exercise participants have demonstrated comparability within the |0-1| z-range for many elements, based on the use of 10 % of the consensus mean as the performance criterion. For any given element, the z-score range $|z| = 0\text{-}1$ implies that a laboratory in this subgroup can distinguish between two samples when their respective analyte concentrations differ by 0 to 20 %. The z-scores are scalable so any laboratory may wish to challenge their performance using the qualitative IUPAC guidelines. For example, a laboratory that scores a $z = -0.7$ based on a σ_{target} of 10 % of the consensus mean, would score a $z = -1.4$, if the performance criterion was tightened to $\sigma_{target} = 5$ % of the consensus mean. The scaled result in this example would still be classified as "satisfactory" ($|z| \leq 2$). The higher z-scores for Sn and V stand out in that many laboratories exhibit unsatisfactory z-scores ($|z| \geq 3$). This is probably due to a combination of facts as the concentration of these elements in QC03LH3 is rather low and the confidence intervals about the consensus mean estimates are rather large.

Laboratory p-scores (Appendix C) were typically < 10% RSD for all elements. This type of precision (or better) should be expected for atomic spectroscopy measurements. This implies that QC03LH3 is a relatively homogeneous material, as inflated, wild ranging p-scores for large subsets of laboratories would be indicative of a within jar homogeneity problem for any particular element. The p-scores are necessarily inversely correlated with the maximum likelihood weights assigned to each laboratory for a particular element because of the nature of the consensus mean estimation model employed.

CONCLUSIONS

It will take several iterations of the exercise before a full assessment of the state of the practice of trace element measurements in marine mammals can be completed. The first iteration of this quality assurance exercise in 2000 was a modest endeavor, as only seven laboratories participated. However the 2001 and 2003 exercises have demonstrated that the scope of this quality assurance exercise is expanding beyond the interests of the marine mammal contaminants community to the analytical chemistry community as a whole, as numerous domestic and international health, environmental and diagnostic laboratories have been brought in as participants. It is hoped that a core group of these laboratories will regularly participate in future exercises to help underpin and improve the quality of measurements in environmentally important biological tissues.

References

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3. NIST/SEMATECH e-Handbook of Statistical Methods, http://www.itl.nist.gov/div898/handbook/, Section 1.3.3.31, April 19, 2004

ACKNOWLEDGEMENTS

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Appendix A: List of Participating Institutions

List of Participating Institutions

U. S. Participants	International Participants
Carlsbad Environmental Monitoring and Research Center	Australian Government Analytical Laboratories (Melbourne)
Midwest Research Institute Florida Division	Australian Government Analytical Laboratories Australia (Sydney)
Oklahoma Animal Disease Diagnostic Laboratory	Australian Nuclear Science and Technology Organization Australia
Texas A&M University College of Veterinary Medicine	Department of Chemistry Chungnam University South Korea
U.S. Department of Agriculture Beltsville Human Nutrition Research Center	GALAB Laboratories Germany
University of Connecticut Environmental Research Institute	Institute of Chemistry and Analytical Chemistry Karl-Franzens Universitaet Graz Austria
University of Iowa Hygienic Laboratory	Izmir Institute of Technology Turkey
University of Maine Environmental Chemistry Laboratory	Kinectrics Inc. Canada
University of Maryland Eastern Shore Department of Chemistry	Ontario Ministry of Environment Canada
University of Massachusetts Department of Chemistry	Politechnika Poznanska Department of Analytical Chemistry Poland
University of Pennsylvania School of Veterinary Medicine	PSC Analytical Services Canada
	The Centre for Environment, Fisheries and Aquaculture Science United Kingdom
	Ultra-Trace Analyses Aquitaine (UT2A) University of Pau France

Appendix B: Tabular Results from Outlier Testing

Table 1. Individual results and summary statistics (mg/kg) for replicate aliquots of QC97LH2, including results from outlier testing.

	Element	As	Cd	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
	Target Mean	**0.391**	**2.35**	**13.16**	**668**	**40.31**	**2.37**	**0.685**	**1.31**	**24.30**	**0.044**	**0.295**	**26.31**
	Target ± 20%	**0.313-0.469**	**1.88-2.82**	**10.53-15.79**	**534-802**	**32.25-48.37**	**1.90-2.84**	**0.548-0.822**	**1.05-1.57**	**19.44-29.16**	**0.040-0.050**	**0.240-0.350**	**21.05-31.57**
	Outlier Labs	**2,4,14,19**	**14**	**None**	**2,23**	**22**	**2,22**	**2,6,19,23**	**6,19**	**2,6**	**15,23**	**13,16,19,22,23**	**2,23**
Lab. #	**Sample ID**	**As**	**Cd**	**Cu**	**Fe**	**Hg**	**Mn**	**Mo**	**Rb**	**Se**	**Sn**	**V**	**Zn**
1	QC97LH2	0.346	2.35	12.49	654	42.11	2.31	0.680	1.42	24.04	0.039	0.300	26.12
1	QC97LH2	0.361	2.40	12.73	664	43.68	2.37	0.710	1.36	24.77	0.040	0.280	26.36
1	QC97LH2	0.358	2.39	12.71	665	44.50	2.37	0.700	1.40	25.19	0.040	0.278	26.90
	Mean	0.355	2.38	12.64	661	43.43	2.35	0.697	1.39	24.67	0.040	0.286	26.46
	Stdev	0.008	0.026	0.133	6	1.214	0.035	0.015	0.031	0.582	0.001	0.012	0.399
	%RSD	2.24%	1.11%	1.05%	0.94%	2.80%	1.47%	2.19%	2.19%	2.36%	1.46%	4.25%	1.51%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
2	QC97LH2	0.301	2.21	12.18	819		1.82	0.100		17.13			20.37
2	QC97LH2	0.295	2.25	12.06	820		1.78	0.165		17.49			20.39
2	QC97LH2	0.286	2.36	11.96	819		1.83	0.122		17.08			19.82
2	QC97LH2	0.345	2.20	12.25	819		1.83	0.101		16.91			20.04
2	QC97LH2	0.321	2.18	12.57	819		1.88	0.197		16.99			20.91
	Mean	0.310	2.24	12.20	819		1.83	0.137		17.12			20.31
	Stdev	0.024	0.071	0.233	0.300		0.034	0.043		0.223			0.413
	%RSD	7.62%	3.19%	1.91%	0.04%		1.84%	31.13%		1.30%			2.03%
	Outlier Test: P or F	Fail	Pass	Pass	Fail		Fail	Fail		Fail			Fail
3	QC97LH2	0.366	2.50	13.39	669	44.13	2.47	0.626	1.27	23.89	0.046	0.294	26.78
3	QC97LH2	0.370	2.47	13.07	671	44.55	2.43	0.613	1.30	24.28	0.045	0.292	26.72
3	QC97LH2	0.379	2.51	13.35	679	44.69	2.42	0.612	1.29	23.81	0.045	0.294	26.53
	Mean	0.372	2.49	13.27	673	44.46	2.44	0.617	1.29	23.99	0.045	0.293	26.68
	Stdev	0.007	0.020	0.174	5	0.291	0.024	0.008	0.014	0.251	0.000	0.001	0.131
	%RSD	1.75%	0.79%	1.31%	0.75%	0.66%	1.00%	1.31%	1.06%	1.05%	0.99%	0.43%	0.49%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
4	QC97LH2	0.551	2.88	14.01	648		2.98	0.648		27.92			25.19
4	QC97LH2	0.532	2.60	12.41	599		2.38	0.596		24.46			24.46
4	QC97LH2	0.484	2.46	13.02	655		2.30	0.576		25.58			25.71
	Mean	0.522	2.65	13.15	634		2.55	0.607		25.99			25.12
	Stdev	0.035	0.217	0.807	30		0.374	0.037		1.765			0.628
	%RSD	6.61%	8.19%	6.14%	4.79%		14.67%	6.13%		6.79%			2.50%
	Outlier Test: P or F	Fail	Pass	Pass	Pass		Pass	Pass		Pass			Pass
5	QC97LH2	0.407	2.31	12.32	705	41.08	2.31	0.679		22.34	0.048		28.48
5	QC97LH2	0.378	2.32	13.13	675	39.92	2.49	0.722		22.11	0.046		28.62
5	QC97LH2	0.331	2.34	13.13	731	41.54	2.40	0.700		22.64	0.043		29.53
	Mean	0.372	2.32	12.86	704	40.85	2.40	0.700		22.36	0.046		28.88
	Stdev	0.038	0.017	0.470	28	0.837	0.092	0.022		0.267	0.003		0.572
	%RSD	10.20%	0.72%	3.66%	4.01%	2.05%	3.81%	3.08%		1.20%	6.14%		1.98%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Pass		Pass

Table 1. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC97LH2, including results from outlier testing.

Lab. #	Sample ID	As	Cd	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
6	QC97LH2	0.346	2.31	13.40	747	45.39	2.80	0.508	0.89	17.90		0.252	28.66
6	QC97LH2	0.329	2.35	12.91	756	45.15	2.78	0.486	0.92	17.17		0.228	23.78
6	QC97LH2	0.356	2.48	13.51	818	45.16	2.76	0.529	0.98	17.79		0.270	30.60
	Mean	0.344	2.38	13.27	774	45.23	2.78	0.508	0.93	17.62		0.250	27.68
	Stdev	0.014	0.089	0.319	39	0.136	0.020	0.022	0.043	0.394		0.021	3.514
	%RSD	3.97%	3.73%	2.41%	5.04%	0.30%	0.70%	4.24%	4.59%	2.23%		8.43%	12.70%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Fail	Fail	Fail		Pass	Pass
7	QC97LH2	0.384	2.41	13.10	671	39.90	2.38	0.712	1.26	22.44	0.046	0.275	24.61
7	QC97LH2	0.411	2.31	13.20	664	40.70	2.38	0.698	1.29	21.11	0.045	0.280	25.28
7	QC97LH2	0.375	2.40	12.80	681	39.60	2.47	0.677	1.26	23.16	0.047	0.281	23.60
	Mean	0.390	2.37	13.03	672	40.07	2.41	0.696	1.27	22.24	0.046	0.279	24.50
	Stdev	0.019	0.055	0.208	9	0.569	0.053	0.018	0.018	1.043	0.001	0.003	0.847
	%RSD	4.80%	2.32%	1.60%	1.27%	1.42%	2.21%	2.53%	1.44%	4.69%	2.17%	1.15%	3.46%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
8	QC97LH2	0.356	2.60	14.12		40.34	2.62			25.88			26.08
8	QC97LH2	0.343	2.56	14.13		39.92	2.68			25.05			26.77
8	QC97LH2	0.364	2.64	14.30		39.91	2.76			26.84			26.91
	Mean	0.354	2.60	14.18		40.06	2.68			25.92			26.59
	Stdev	0.011	0.043	0.101		0.245	0.068			0.897			0.444
	%RSD	2.99%	1.64%	0.71%		0.61%	2.54%			3.46%			1.67%
	Outlier Test: P or F	Pass	Pass	Pass		Pass	Pass			Pass			Pass
9	QC97LH2	0.399	2.38	13.13	674	43.95	2.42	0.692		24.64	0.045	0.301	26.19
9	QC97LH2	0.393	2.31	13.22	668	41.73	2.32	0.674		24.02	0.043	0.301	26.48
9	QC97LH2	0.381	2.35	13.13	663	35.25	2.37	0.689		24.24	0.044	0.296	26.26
	Mean	0.391	2.35	13.16	668	40.31	2.37	0.685		24.30	0.044	0.299	26.31
	Stdev	0.009	0.035	0.052	6	4.520	0.053	0.010		0.314	0.001	0.003	0.151
	%RSD	2.30%	1.47%	0.39%	0.83%	11.21%	2.24%	1.43%		1.29%	1.69%	1.10%	0.58%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass
10	QC97LH2	0.411290323	2.50	13.15	668	44.82	2.35	0.710	1.37	25.00		0.298	27.30
10	QC97LH2	0.411290323	2.52	12.98	694	45.18	2.40	0.702	1.26	25.56		0.306	28.11
10	QC97LH2	0.403225806	2.32	12.90	635	44.17	2.37	0.669	1.27	24.92		0.298	25.76
	Mean	0.409	2.45	13.01	666	44.72	2.37	0.694	1.30	25.16		0.301	27.06
	Stdev	0.005	0.112	0.123	29	0.509	0.028	0.021	0.063	0.352		0.005	1.191
	%RSD	1.14%	4.57%	0.95%	4.43%	1.14%	1.19%	3.08%	4.85%	1.40%		1.55%	4.40%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Pass
11	QC97LH2			13.67	652		2.57						27.22
11	QC97LH2			13.10	624		2.46						25.60
11	QC97LH2			13.91	658		2.60						27.30
	Mean			13.56	645		2.54						26.71
	Stdev			0.416	18.148		0.074						0.959
	%RSD			3.07%	2.82%		2.90%						3.59%
	Outlier Test: P or F			Pass	Pass		Pass						Pass

Table 1. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC97LH2, including results from outlier testing.

Lab. #	Sample ID	As	Cd	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
12	QC97LH2	0.428	2.64	13.38	693	39.33	2.44	0.677	1.31	24.90	0.041	0.289	26.89
12	QC97LH2	0.394	2.69	13.70	700	38.97	2.50	0.686	1.34	24.88	0.046	0.322	26.54
12	QC97LH2	0.433	2.68	13.64	706	39.27	2.53	0.692	1.36	25.23	0.045	0.335	26.74
	Mean	0.418	2.67	13.57	700	39.19	2.49	0.685	1.34	25.00	0.044	0.315	26.72
	Stdev	0.021	0.026	0.170	7	0.193	0.046	0.008	0.025	0.197	0.003	0.024	0.176
	%RSD	5.07%	0.99%	1.25%	0.93%	0.49%	1.84%	1.10%	1.88%	0.79%	6.01%	7.52%	0.66%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
13	QC97LH2	0.430	2.42	11.53	697	33.80	2.24	0.730	1.25	23.12		0.330	29.87
13	QC97LH2	0.460	2.50	11.74	684	33.82	2.30	0.740	1.24	23.60		0.340	27.93
13	QC97LH2	0.470	2.51	12.17	714	34.15	2.33	0.750	1.26	23.87		0.400	29.00
	Mean	0.453	2.47	11.81	698	33.92	2.29	0.740	1.25	23.53		0.357	28.93
	Stdev	0.021	0.052	0.326	15.096	0.197	0.046	0.010	0.010	0.380		0.038	0.972
	%RSD	4.59%	2.10%	2.76%	2.16%	0.58%	2.00%	1.35%	0.80%	1.61%		10.61%	3.36%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Fail	Pass
14	QC97LH2	0.860	2.21	14.22	654	46.05	2.25						33.42
14	QC97LH2	0.827	1.70	14.04	707	49.02	2.07						44.69
14	QC97LH2	0.621	1.71	13.11	665	48.06	2.00						39.23
14	QC97LH2	0.732		13.05		45.20							32.50
	Mean	0.760	1.87	13.61	675	47.08	2.10						37.46
	Stdev	0.107	0.290	0.611	28	1.763	0.129						5.667
	%RSD	14.12%	15.52%	4.49%	4.19%	3.74%	6.15%						15.13%
	Outlier Test: P or F	Fail	Fail	Pass	Pass	Pass	Pass						Fail
15	QC97LH2	0.400	2.56	13.40	721	44.80	2.50	0.670		26.60	0.060	0.310	28.00
15	QC97LH2	0.400	2.56	13.50	710	44.60	2.50	0.660		26.40	0.130	0.310	28.00
15	QC97LH2	0.390	2.47	13.10	699	44.30	2.40	0.660		25.50	0.060	0.300	27.00
	Mean	0.397	2.53	13.33	710	44.57	2.47	0.663		26.17	0.083	0.307	27.67
	Stdev	0.006	0.052	0.208	11	0.252	0.058	0.006		0.586	0.040	0.006	0.577
	%RSD	1.46%	2.05%	1.56%	1.55%	0.56%	2.34%	0.87%		2.24%	48.50%	1.88%	2.09%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Fail	Pass	Pass
16	QC97LH2	0.382	2.35	15.91	721	36.87	2.30	0.691	1.30	22.36		0.031	28.20
16	QC97LH2	0.388	2.30	15.34	715	36.38	2.37	0.676	1.30	22.89		0.293	27.30
16	QC97LH2	0.393	2.41	15.99	717	36.71	2.39	0.667	1.33	22.94		0.297	28.50
	Mean	0.387	2.35	15.75	717	36.65	2.35	0.678	1.31	22.73		0.207	28.00
	Stdev	0.005	0.055	0.354	3	0.250	0.047	0.012	0.017	0.321		0.153	0.624
	%RSD	1.34%	2.34%	2.25%	0.42%	0.68%	2.01%	1.76%	1.26%	1.41%		73.80%	2.23%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Fail	Pass
17	QC97LH2	0.392	2.22	11.12	693		2.32	0.628		22.09		0.262	24.22
17	QC97LH2	0.433	2.28	12.41	696		2.36	0.664		21.35		0.320	26.07
17	QC97LH2	0.321	2.41	12.55	792		2.42	0.631		21.48		0.342	25.24
	Mean	0.382	2.31	12.03	727		2.37	0.641		21.64		0.308	25.18
	Stdev	0.057	0.095	0.790	57		0.051	0.020		0.396		0.042	0.926
	%RSD	14.83%	4.12%	6.56%	7.80%		2.14%	3.13%		1.83%		13.49%	3.68%
	Outlier Test: P or F	Pass	Pass	Pass	Pass		Pass	Pass		Pass		Pass	Pass

Table 1. (continued): Individual results and summary statistics (mg/kg) for replicate aliquots of QC97LH2, including results from outlier testing.

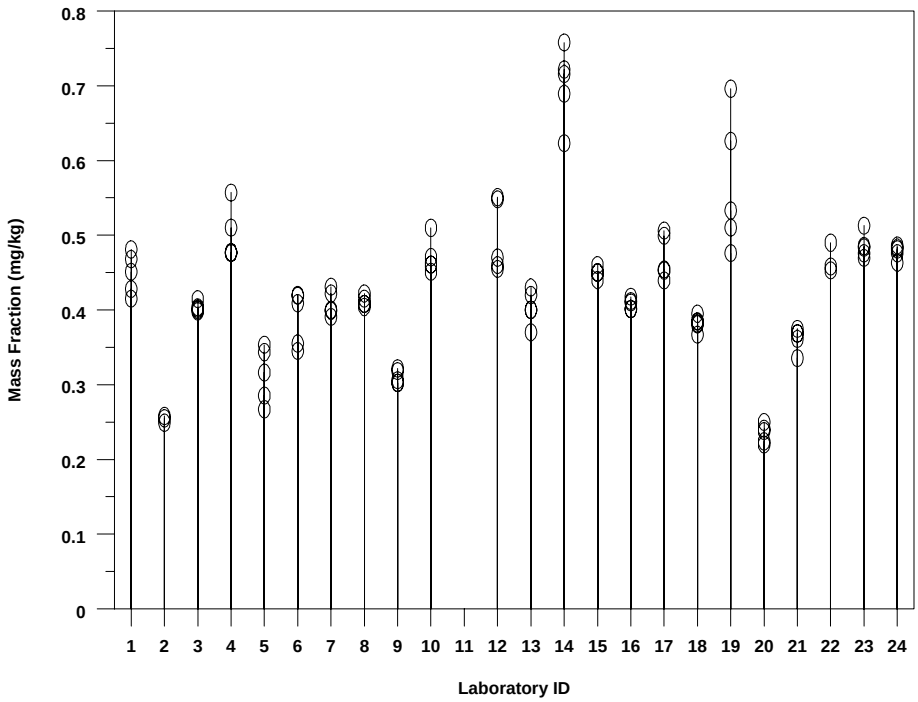
Lab. #	Sample ID	As	Cd	Cu	Fe	Hg	Mn	Mo	Rb	Se	Sn	V	Zn
18	QC97LH2	0.514	2.51	11.84	629	40.82	2.11	0.614	1.15	24.56	0.047	0.284	27.03
18	QC97LH2	0.511	2.48	12.78	620	44.63	2.09	0.610	1.22	24.38	0.048	0.280	26.86
18	QC97LH2	0.477	2.41	12.41	608	37.50	2.07	0.595	1.21	23.50	0.053	0.278	25.67
18	QC97LH2	0.381	2.44	12.77	628	38.57	2.14	0.607	1.23	24.16	0.053	0.288	26.47
18	QC97LH2	0.442	2.45	12.51	632	41.44	2.10	0.612	1.21	24.11	0.041	0.293	25.86
18	QC97LH2	0.361	2.42	12.82	629	35.88	2.09	0.604	1.07	23.47	0.053	0.280	25.84
	Mean	0.448	2.45	12.52	624	39.81	2.10	0.607	1.18	24.03	0.049	0.284	26.29
	Stdev	0.065	0.037	0.373	9	3.138	0.023	0.007	0.063	0.452	0.005	0.006	0.579
	%RSD	14.51%	1.51%	2.98%	1.42%	7.88%	1.08%	1.10%	5.30%	1.88%	9.84%	2.00%	2.20%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
19	QC97LH2	1.090	2.35	13.00	697	39.50	2.28	0.617	1.21	22.30	0.050	0.367	28.70
19	QC97LH2	1.200	2.38	13.00	696	40.40	2.41	0.623	1.24	22.80	0.054	0.383	29.30
19	QC97LH2	0.796	2.42	13.80	700	40.30	2.87	2.060	2.47	21.30	<0.05	0.929	26.20
	Mean	1.029	2.38	13.27	698	40.07	2.52	1.100	1.64	22.13	0.052	0.560	28.07
	Stdev	0.209	0.035	0.462	2	0.493	0.310	0.831	0.719	0.764	0.003	0.320	1.644
	%RSD	20.30%	1.47%	3.48%	0.30%	1.23%	12.30%	75.58%	43.84%	3.45%	5.44%	57.17%	5.86%
	Outlier Test: P or F	Fail	Pass	Pass	Pass	Pass	Pass	Fail	Fail	Pass	Pass	Fail	Pass
20	QC97LH2	0.373	2.01	14.73	613	35.38	2.28			26.49	0.045		27.83
20	QC97LH2	0.390	2.25	13.48	646	40.17	2.19			22.38	0.045		27.53
20	QC97LH2	0.358	2.28	14.11	628	38.56	2.33			22.87	0.050		26.21
	Mean	0.374	2.18	14.11	629	38.04	2.27			23.91	0.047		27.19
	Stdev	0.016	0.147	0.625	16	2.438	0.074			2.245	0.003		0.862
	%RSD	4.28%	6.74%	4.43%	2.59%	6.41%	3.27%			9.39%	6.19%		3.17%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass			Pass	Pass		Pass
21	QC97LH2	0.379	2.40	12.73	710	44.34	2.48	0.690	1.30	22.98	0.050	0.293	26.89
21	QC97LH2	0.359	2.40	12.94	686	42.09	2.47	0.645	1.32	22.85	0.041	0.294	27.98
21	QC97LH2	0.386	2.41	13.37	706	45.10	2.34	0.702	1.31	23.67	0.037	0.295	28.10
	Mean	0.375	2.40	13.01	701	43.84	2.43	0.679	1.31	23.17	0.042	0.294	27.66
	Stdev	0.014	0.005	0.326	13	1.565	0.079	0.030	0.011	0.441	0.007	0.001	0.667
	%RSD	3.82%	0.19%	2.51%	1.85%	3.57%	3.24%	4.39%	0.83%	1.90%	16.11%	0.36%	2.41%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass	Pass
22	QC97LH2	0.329	2.25	12.57	680	31.90	1.56	0.591	1.20	19.12	0.046	0.230	24.52
22	QC97LH2	0.345	2.10	12.40	663	32.90	1.43	0.564	1.13	20.04	0.045	0.220	23.41
22	QC97LH2	0.340	2.19	13.20	653	30.30	1.54	0.582	1.13	20.60	0.041	0.210	23.53
	Mean	0.338	2.18	12.72	665	31.70	1.51	0.579	1.15	19.92	0.044	0.220	23.82
	Stdev	0.008	0.075	0.421	14	1.311	0.070	0.014	0.040	0.747	0.003	0.010	0.609
	%RSD	2.42%	3.46%	3.31%	2.05%	4.14%	4.64%	2.37%	3.50%	3.75%	6.01%	4.55%	2.56%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Fail	Fail	Pass	Pass	Pass	Pass	Fail	Pass
23	QC97LH2	0.436	2.52	11.37	7021		2.58	449.700	1.27	22.24	11.500	0.360	18.20
23	QC97LH2	0.440	2.56	11.51	7203		2.61	462.170	1.29	22.68	13.420	0.362	18.69
23	QC97LH2	0.444	2.49	11.25	6843		2.55	437.204	1.24	21.82	9.564	0.355	17.68
	Mean	0.440	2.52	11.38	7022		2.58	449.691	1.27	22.25	11.495	0.359	18.19
	Stdev	0.004	0.037	0.127	180		0.033	12.483	0.025	0.427	1.928	0.003	0.509
	%RSD	0.99%	1.45%	1.12%	2.56%		1.26%	2.78%	1.94%	1.92%	16.77%	0.95%	2.80%
	Outlier Test: P or F	Pass	Pass	Pass	Fail		Pass	Fail	Pass	Pass	Fail	Fail	Fail
24	QC97LH2	0.408	2.37	13.57	651	39.90	2.42	0.670		23.47	0.040	0.294	26.53
24	QC97LH2	0.408	2.36	13.82	671	39.21	2.38	0.657		23.65	0.042	0.306	26.23
24	QC97LH2	0.413	2.33	13.38	666	39.35	2.27	0.665		23.39	0.037	0.305	26.22
	Mean	0.410	2.35	13.59	663	39.49	2.36	0.664		23.50	0.039	0.302	26.33
	Stdev	0.003	0.020	0.221	10	0.365	0.080	0.006		0.133	0.003	0.006	0.176
	%RSD	0.73%	0.86%	1.62%	1.58%	0.92%	3.39%	0.97%		0.57%	6.51%	2.05%	0.67%
	Outlier Test: P or F	Pass	Pass	Pass	Pass	Pass	Pass	Pass		Pass	Pass	Pass	Pass

Appendix C: Consensus Data Tables, z- and p-scores and Consensus Mean Plots

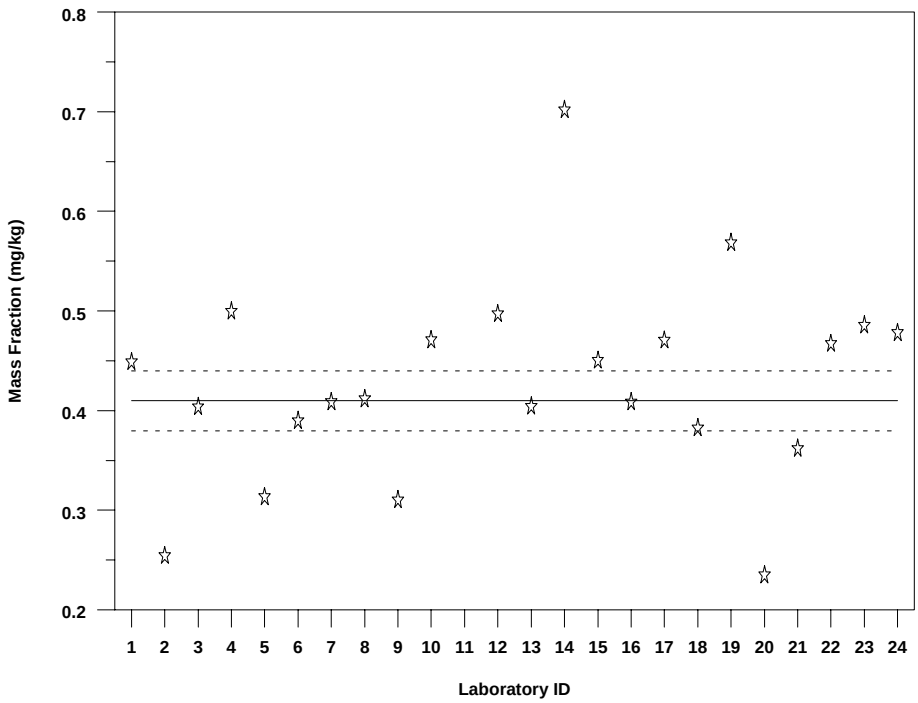
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
As	0.410	0.380	0.440	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.449	7.46E-04	2.73E-02	1.49E-04	0.967	1.48E-04	0.95	0.61
3	5	0.404	4.08E-05	6.39E-03	8.16E-06	0.998	8.15E-06	-0.15	0.16
5	5	0.313	1.36E-03	3.69E-02	2.72E-04	0.940	2.77E-04	-2.36	1.18
6	5	0.390	1.34E-03	3.66E-02	2.68E-04	0.943	2.64E-04	-0.49	0.94
7	5	0.409	2.93E-04	1.71E-02	5.86E-05	0.987	5.84E-05	-0.03	0.42
8	5	0.411	5.08E-05	7.13E-03	1.02E-05	0.998	1.02E-05	0.04	0.17
9	5	0.310	8.41E-05	9.17E-03	1.68E-05	0.996	1.68E-05	-2.43	0.30
10	5	0.471	5.29E-04	2.30E-02	1.06E-04	0.976	1.06E-04	1.48	0.49
12	5	0.497	2.34E-03	4.84E-02	4.69E-04	0.902	4.75E-04	2.12	0.97
13	5	0.404	5.30E-04	2.30E-02	1.06E-04	0.976	1.05E-04	-0.14	0.57
15	5	0.450	5.00E-05	7.07E-03	1.00E-05	0.998	1.00E-05	0.98	0.16
16	5	0.408	5.10E-05	7.14E-03	1.02E-05	0.998	1.02E-05	-0.03	0.17
17	5	0.470	9.10E-04	3.02E-02	1.82E-04	0.960	1.82E-04	1.48	0.64
18	6	0.382	8.23E-05	9.07E-03	1.37E-05	0.997	1.37E-05	-0.67	0.24
20	5	0.235	1.54E-04	1.24E-02	3.08E-05	0.993	3.11E-05	-4.28	0.53
21	5	0.362	2.37E-04	1.54E-02	4.74E-05	0.989	4.73E-05	-1.17	0.43
22	3	0.467	4.03E-04	2.01E-02	1.34E-04	0.970	1.34E-04	1.40	0.43
23	5	0.485	2.74E-04	1.65E-02	5.48E-05	0.988	5.48E-05	1.84	0.34
24	5	0.478	8.26E-05	9.09E-03	1.65E-05	0.996	1.65E-05	1.66	0.19
Outliers									
2	3	0.254	2.10E-05	4.58E-03	7.00E-06	-	-	-3.80	0.18
4	5	0.499	1.25E-03	3.53E-02	2.49E-04	-	-	2.19	0.71
14	5	0.702	2.53E-03	5.03E-02	5.05E-04	-	-	7.12	0.72
19	5	0.568	8.20E-03	9.06E-02	1.64E-03	-	-	3.86	1.59

Raw data plot for As in QC03LH3



Consensus mean plot for As in QC03LH3



Replicates

Laboratory Mean

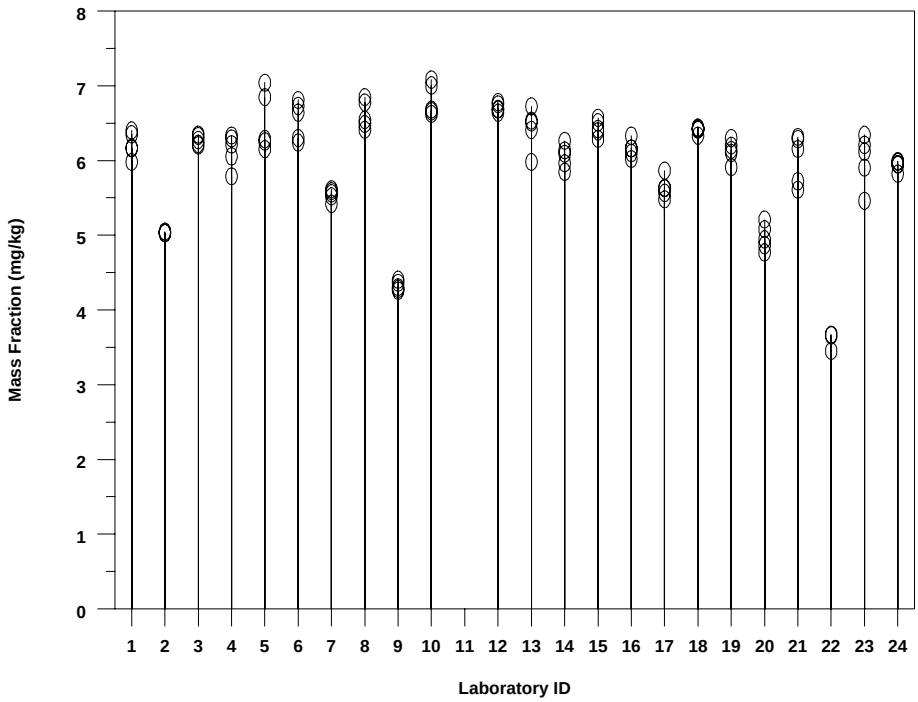
Consensus Mean

Consensus Mean 95% C.L.

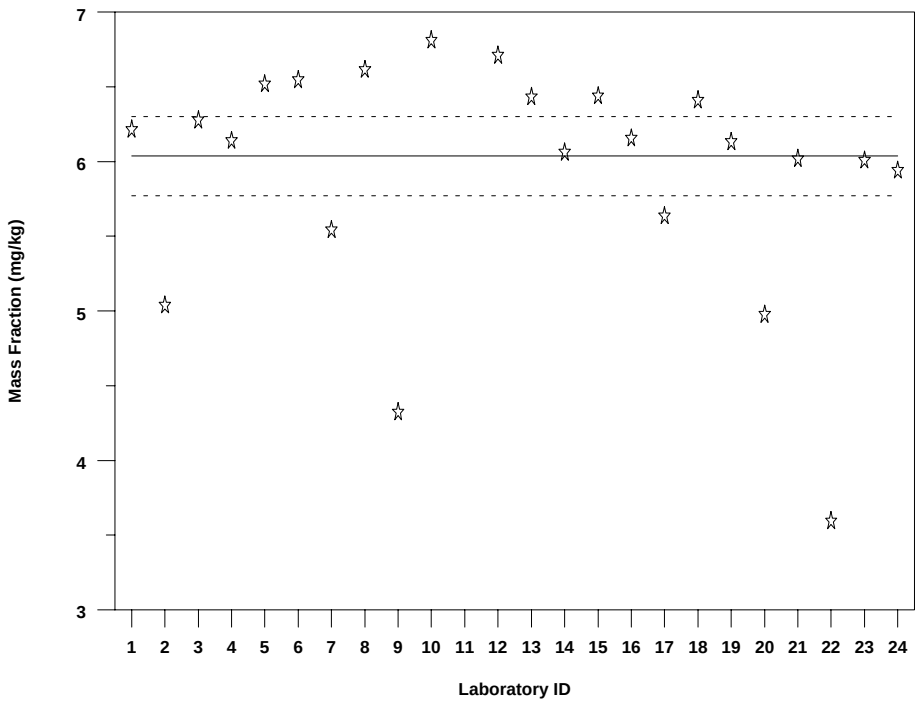
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Cd	6.04	5.77	6.30	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	6.21	2.82E-02	0.168	5.63E-03	0.985	5.62E-03	0.29	0.27
2	3	5.04	1.42E-04	0.012	4.74E-05	1.000	4.74E-05	-1.66	0.02
3	5	6.27	3.94E-03	0.063	7.89E-04	0.998	7.89E-04	0.39	0.10
4	5	6.14	4.96E-02	0.223	9.92E-03	0.975	9.86E-03	0.17	0.36
5	5	6.52	1.60E-01	0.400	3.20E-02	0.922	3.17E-02	0.80	0.61
6	5	6.54	6.66E-02	0.258	1.33E-02	0.966	1.33E-02	0.84	0.39
7	5	5.54	5.81E-03	0.076	1.16E-03	0.997	1.16E-03	-0.82	0.14
8	5	6.61	3.55E-02	0.188	7.10E-03	0.982	7.09E-03	0.96	0.28
9	5	4.32	3.58E-03	0.060	7.15E-04	0.998	7.18E-04	-2.84	0.14
10	5	6.81	4.68E-02	0.216	9.35E-03	0.976	9.39E-03	1.28	0.32
12	5	6.71	3.17E-03	0.056	6.34E-04	0.998	6.34E-04	1.11	0.08
13	5	6.43	7.63E-02	0.276	1.53E-02	0.961	1.52E-02	0.65	0.43
15	5	6.44	1.18E-02	0.109	2.36E-03	0.994	2.35E-03	0.66	0.17
16	5	6.15	1.30E-02	0.114	2.60E-03	0.993	2.59E-03	0.20	0.19
17	5	5.63	2.03E-02	0.143	4.07E-03	0.989	4.06E-03	-0.67	0.25
18	6	6.41	1.51E-03	0.039	2.51E-04	0.999	2.51E-04	0.62	0.06
19	5	6.13	2.08E-02	0.144	4.16E-03	0.989	4.15E-03	0.16	0.24
20	5	4.97	3.03E-02	0.174	6.06E-03	0.984	6.10E-03	-1.76	0.35
21	5	6.02	1.08E-01	0.329	2.17E-02	0.946	2.14E-02	-0.03	0.55
23	5	6.01	1.19E-01	0.345	2.38E-02	0.941	2.35E-02	-0.05	0.57
24	5	5.94	4.52E-03	0.067	9.05E-04	0.998	9.04E-04	-0.16	0.11
Outliers									
14	5	6.06	2.55E-02	0.160	5.10E-03	-	-	0.04	0.26
22	3	3.59	1.54E-02	0.124	5.14E-03	-	-	-4.05	0.35

Raw data plot for Cd in QC03LH3



Consensus mean plot for Cd in QC03LH3



Replicates

Laboratory Mean

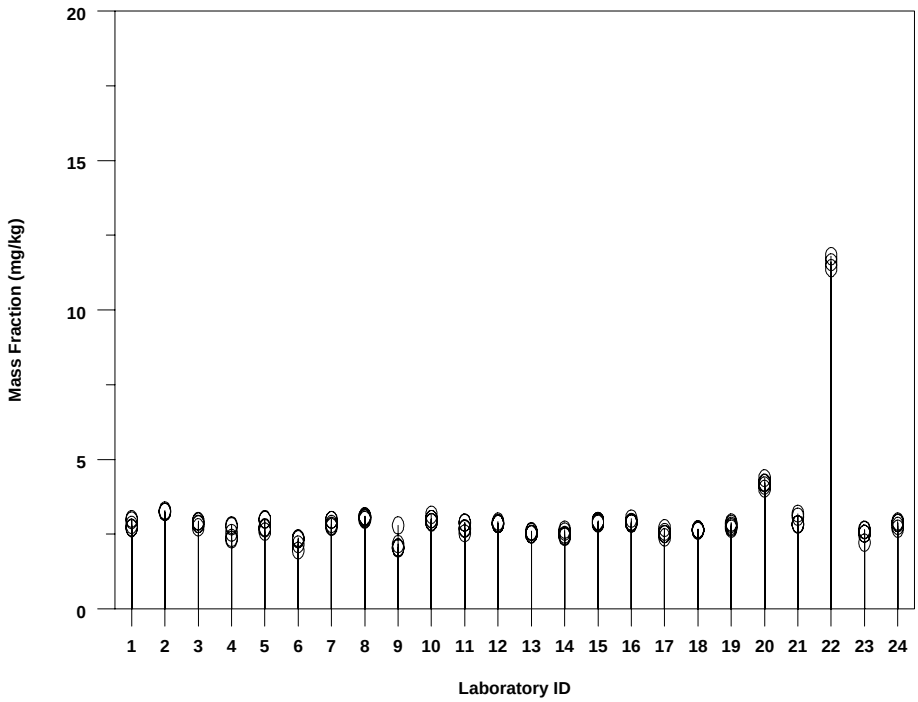
Consensus Mean

Consensus Mean 95% C.L.

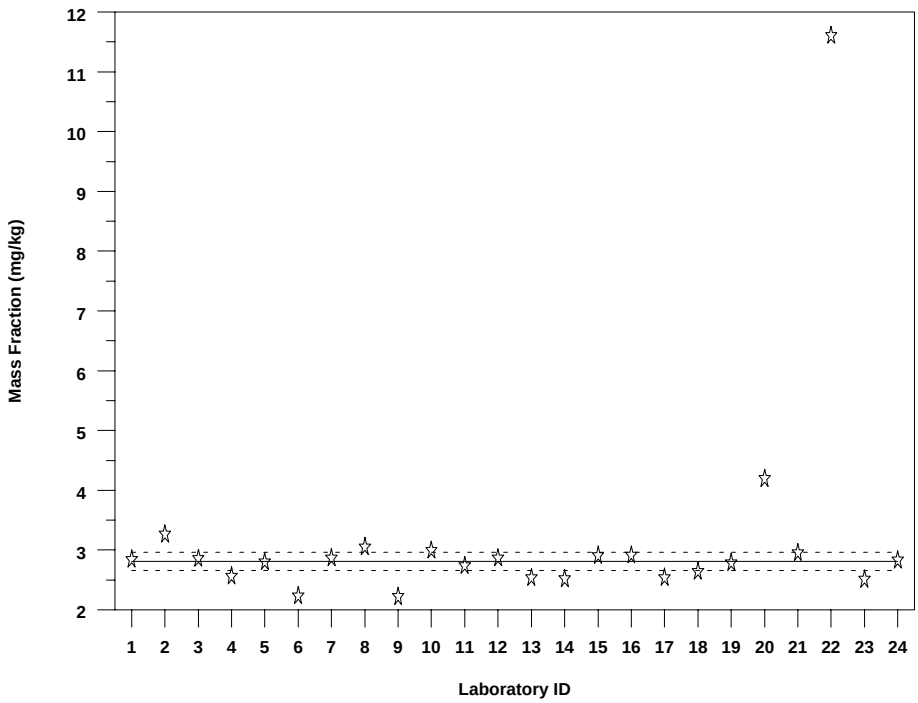
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Cu	2.81	2.66	2.96	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	2.84	1.96E-02	0.140	3.91E-03	0.973	3.88E-03	0.11	0.49
2	3	3.26	7.00E-04	0.026	2.33E-04	0.998	2.33E-04	1.60	0.08
3	5	2.85	6.93E-03	0.083	1.39E-03	0.990	1.38E-03	0.15	0.29
4	5	2.56	4.77E-02	0.218	9.54E-03	0.936	9.46E-03	-0.89	0.85
5	5	2.80	3.36E-02	0.183	6.73E-03	0.954	6.65E-03	-0.05	0.66
6	5	2.23	3.12E-02	0.177	6.25E-03	0.956	6.34E-03	-2.07	0.79
7	5	2.86	1.25E-02	0.112	2.50E-03	0.982	2.49E-03	0.19	0.39
8	5	3.05	2.71E-03	0.052	5.42E-04	0.996	5.42E-04	0.84	0.17
9	5	2.22	1.06E-01	0.326	2.12E-02	0.863	2.21E-02	-2.12	1.47
10	5	2.99	1.01E-02	0.101	2.03E-03	0.986	2.02E-03	0.64	0.34
11	5	2.73	2.31E-02	0.152	4.63E-03	0.968	4.59E-03	-0.27	0.56
12	5	2.86	1.22E-03	0.035	2.44E-04	0.998	2.44E-04	0.18	0.12
13	5	2.53	2.47E-03	0.050	4.94E-04	0.996	4.94E-04	-0.99	0.20
14	5	2.51	1.03E-02	0.102	2.07E-03	0.985	2.07E-03	-1.06	0.40
15	5	2.90	1.43E-03	0.038	2.86E-04	0.998	2.86E-04	0.33	0.13
16	5	2.91	4.30E-03	0.066	8.60E-04	0.994	8.59E-04	0.35	0.23
17	5	2.53	1.35E-02	0.116	2.69E-03	0.981	2.69E-03	-0.98	0.46
18	6	2.64	3.57E-04	0.019	5.94E-05	1.000	5.94E-05	-0.61	0.07
19	5	2.78	7.03E-03	0.084	1.41E-03	0.990	1.40E-03	-0.09	0.30
20	5	4.19	1.71E-02	0.131	3.43E-03	0.974	3.72E-03	4.91	0.31
21	5	2.95	2.92E-02	0.171	5.84E-03	0.960	5.79E-03	0.50	0.58
23	5	2.51	3.00E-02	0.173	6.00E-03	0.959	5.98E-03	-1.09	0.69
24	5	2.83	9.53E-03	0.098	1.91E-03	0.987	1.90E-03	0.06	0.35

Raw data plot for Cu in QC03LH3



Consensus mean plot for Cu in QC03LH3



Replicates

Laboratory Mean

Consensus Mean

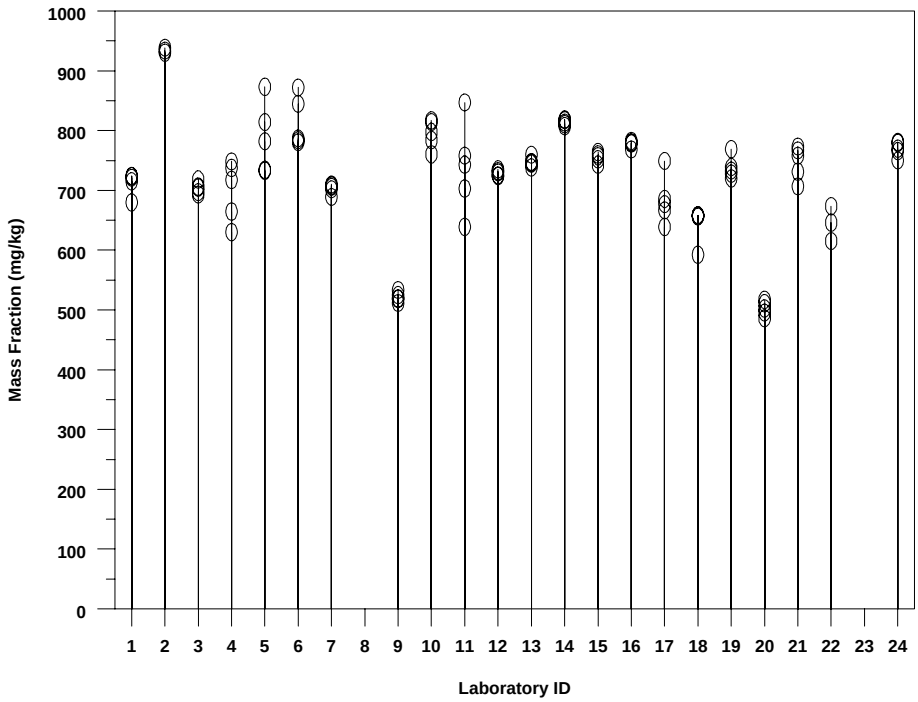
Consensus Mean 95% C.L.

Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Fe	715	680	750	mg/kg

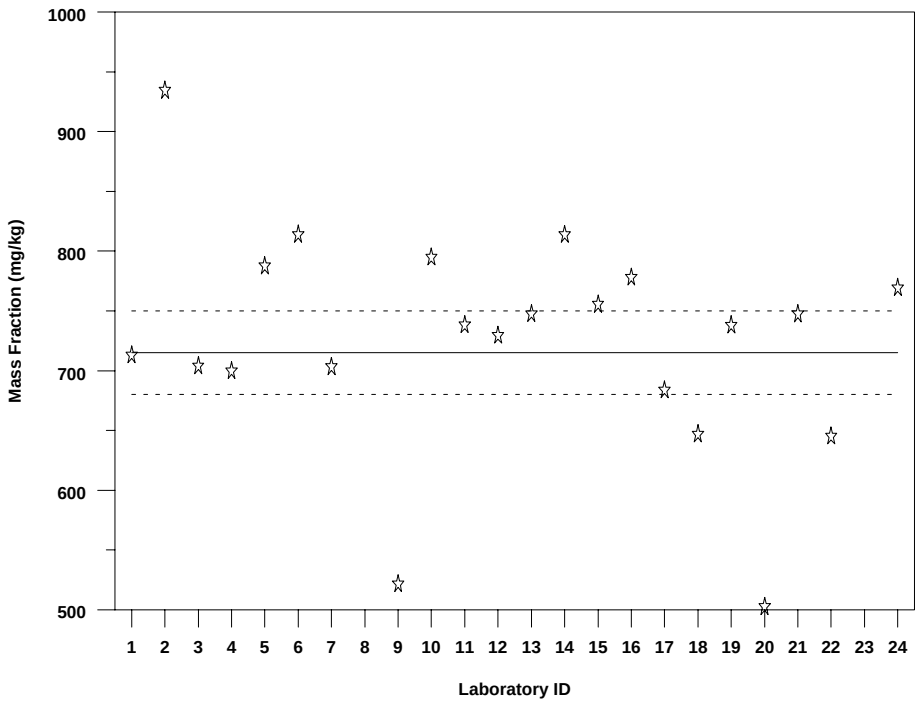
Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	713	3.50E+02	19	7.00E+01	0.989	6.99E+01	-0.03	0.26
3	5	704	9.40E+01	10	1.88E+01	0.997	1.88E+01	-0.16	0.14
4	5	700	2.54E+03	50	5.08E+02	0.929	5.00E+02	-0.22	0.72
5	5	787	3.48E+03	59	6.95E+02	0.904	6.91E+02	1.01	0.75
6	5	814	1.77E+03	42	3.54E+02	0.948	3.56E+02	1.38	0.52
7	5	703	7.00E+01	8	1.40E+01	0.998	1.40E+01	-0.17	0.12
9	5	521	6.56E+01	8	1.31E+01	0.998	1.32E+01	-2.71	0.16
10	5	795	5.47E+02	23	1.09E+02	0.983	1.09E+02	1.11	0.29
11	5	738	5.83E+03	76	1.17E+03	0.852	1.13E+03	0.32	1.03
12	5	729	2.17E+01	5	4.34E+00	0.999	4.34E+00	0.20	0.06
13	5	747	6.11E+01	8	1.22E+01	0.998	1.22E+01	0.45	0.10
14	5	813	2.18E+01	5	4.36E+00	0.999	4.36E+00	1.37	0.06
15	5	755	6.57E+01	8	1.31E+01	0.998	1.31E+01	0.56	0.11
16	5	778	2.92E+01	5	5.85E+00	0.999	5.85E+00	0.88	0.07
17	5	683	1.66E+03	41	3.31E+02	0.952	3.28E+02	-0.44	0.60
18	6	647	7.10E+02	27	1.18E+02	0.982	1.18E+02	-0.96	0.41
19	5	738	3.53E+02	19	7.05E+01	0.989	7.04E+01	0.32	0.25
20	5	502	1.53E+02	12	3.05E+01	0.995	3.07E+01	-2.98	0.25
21	5	747	7.68E+02	28	1.54E+02	0.977	1.53E+02	0.45	0.37
22	3	645	8.51E+02	29	2.84E+02	0.958	2.82E+02	-0.98	0.45
24	5	769	1.56E+02	12	3.11E+01	0.995	3.11E+01	0.75	0.16
Outliers									
2	3	934	1.69E+01	4	5.65E+00	-	-	3.06	0.04
23*	5	7564	1.23E+05	351	2.47E+04	-	-	95.76	0.46

*Note: Data for Laboratory 23 not plotted (off scale)

Raw data plot for Fe in QC03LH3



Consensus mean plot for Fe in QC03LH3



Replicates

Laboratory Mean

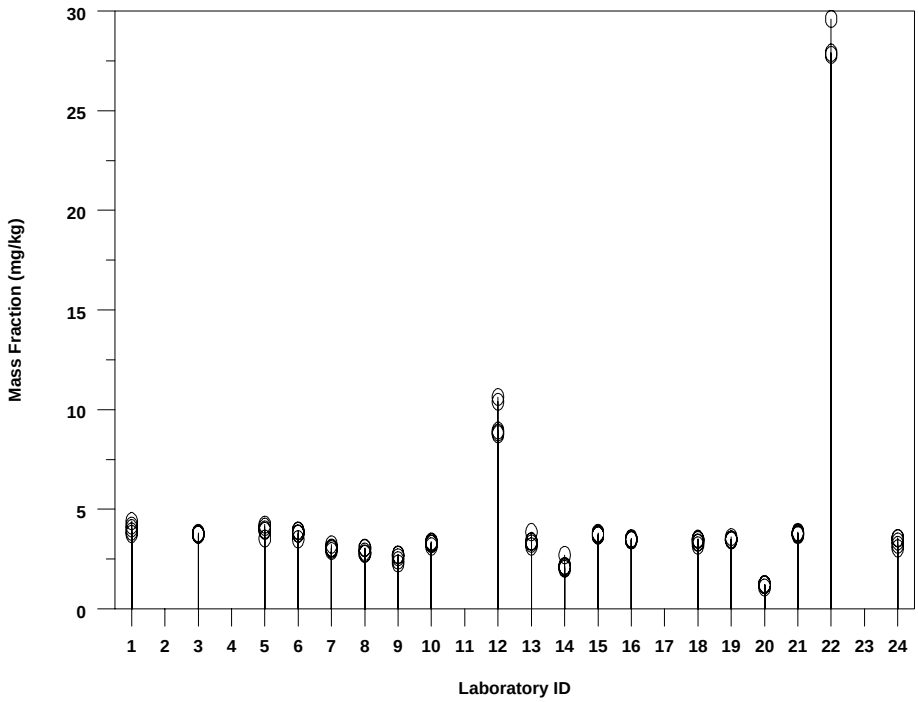
Consensus Mean

Consensus Mean 95% C.L.

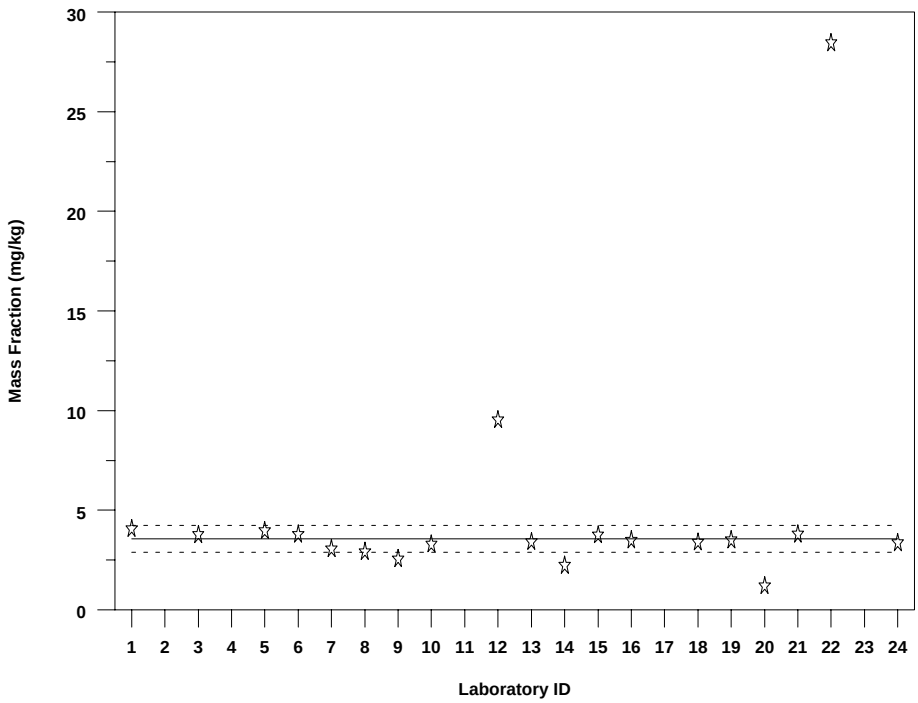
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Hg	**3.56**	**2.89**	**4.23**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	4.05	6.31E-02	0.25	1.26E-02	0.994	1.26E-02	1.37	0.62
3	5	3.75	1.19E-03	0.03	2.38E-04	1.000	2.38E-04	0.53	0.09
5	5	3.95	7.01E-02	0.26	1.40E-02	0.993	1.40E-02	1.09	0.67
6	5	3.78	3.03E-02	0.17	6.06E-03	0.997	6.05E-03	0.60	0.46
7	5	3.05	1.47E-02	0.12	2.93E-03	0.999	2.93E-03	-1.44	0.40
8	5	2.90	2.12E-02	0.15	4.24E-03	0.998	4.24E-03	-1.85	0.50
9	5	2.54	3.54E-02	0.19	7.09E-03	0.997	7.09E-03	-2.86	0.74
10	5	3.28	8.87E-03	0.09	1.77E-03	0.999	1.77E-03	-0.80	0.29
12	5	9.52	8.35E-01	0.91	1.67E-01	0.877	2.92E-01	16.71	0.96
13	5	3.40	7.21E-02	0.27	1.44E-02	0.993	1.44E-02	-0.44	0.79
14	5	2.21	7.70E-02	0.28	1.54E-02	0.993	1.54E-02	-3.79	1.25
15	5	3.73	2.83E-03	0.05	5.66E-04	1.000	5.66E-04	0.48	0.14
16	5	3.48	1.50E-03	0.04	2.99E-04	1.000	2.99E-04	-0.22	0.11
18	6	3.38	1.63E-02	0.13	2.71E-03	0.999	2.71E-03	-0.51	0.38
19	5	3.49	4.07E-03	0.06	8.14E-04	1.000	8.14E-04	-0.20	0.18
20	5	1.19	4.28E-03	0.07	8.57E-04	1.000	8.57E-04	-6.66	0.55
21	5	3.78	3.69E-03	0.06	7.38E-04	1.000	7.38E-04	0.60	0.16
24	5	3.35	4.88E-02	0.22	9.75E-03	0.995	9.74E-03	-0.61	0.66
Outliers									
22	3	28.43	1.02E+00	1.01	3.41E-01	-	-	69.82	0.36

Raw data plot for Hg in QC03LH3



Consensus mean plot for Hg in QC03LH3



Replicates

Laboratory Mean

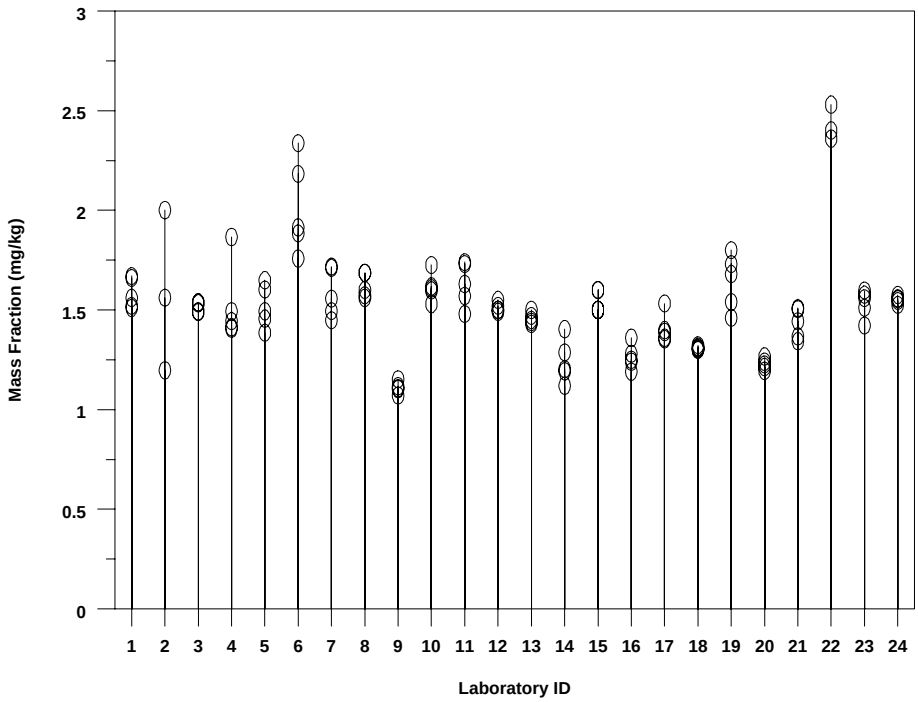
Consensus Mean

Consensus Mean 95% C.L.

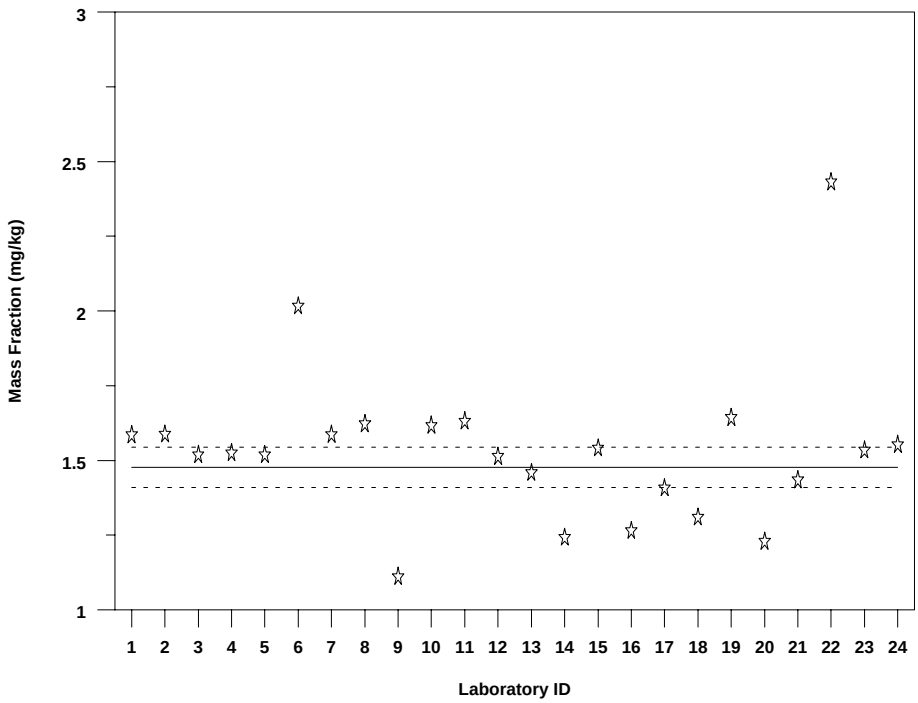
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Mn	**1.48**	**1.41**	**1.54**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	1.58	5.83E-03	0.08	1.17E-03	0.954	1.16E-03	0.72	0.48
3	5	1.52	6.04E-04	0.02	1.21E-04	0.995	1.21E-04	0.27	0.16
4	5	1.52	3.76E-02	0.19	7.53E-03	0.772	7.15E-03	0.32	1.27
5	5	1.52	1.16E-02	0.11	2.32E-03	0.914	2.27E-03	0.27	0.71
6	5	2.02	5.63E-02	0.24	1.13E-02	0.458	2.87E-02	3.64	1.18
7	5	1.59	1.53E-02	0.12	3.06E-03	0.889	3.01E-03	0.73	0.78
8	5	1.62	3.73E-03	0.06	7.46E-04	0.970	7.45E-04	0.97	0.38
9	5	1.11	8.66E-04	0.03	1.73E-04	0.993	1.75E-04	-2.49	0.27
10	5	1.62	4.97E-03	0.07	9.94E-04	0.961	9.92E-04	0.94	0.44
11	5	1.63	1.21E-02	0.11	2.41E-03	0.910	2.40E-03	1.03	0.67
12	5	1.51	5.70E-04	0.02	1.14E-04	0.995	1.14E-04	0.23	0.16
13	5	1.46	7.70E-04	0.03	1.54E-04	0.994	1.54E-04	-0.13	0.19
14	5	1.24	1.18E-02	0.11	2.35E-03	0.909	2.41E-03	-1.60	0.87
15	5	1.54	3.00E-03	0.05	6.00E-04	0.976	5.97E-04	0.42	0.36
16	5	1.26	3.93E-03	0.06	7.86E-04	0.968	7.91E-04	-1.44	0.50
17	5	1.41	5.30E-03	0.07	1.06E-03	0.958	1.05E-03	-0.48	0.52
18	6	1.31	7.87E-05	0.01	1.31E-05	0.999	1.31E-05	-1.14	0.07
19	5	1.64	1.94E-02	0.14	3.88E-03	0.862	3.88E-03	1.11	0.85
20	5	1.23	7.43E-04	0.03	1.49E-04	0.994	1.49E-04	-1.69	0.22
21	5	1.43	5.84E-03	0.08	1.17E-03	0.954	1.16E-03	-0.30	0.53
23	5	1.53	4.89E-03	0.07	9.78E-04	0.961	9.70E-04	0.38	0.46
24	5	1.55	3.36E-04	0.02	6.73E-05	0.997	6.72E-05	0.50	0.12
Outliers									
2	3	1.59	1.62E-01	0.40	5.40E-02	-	-	0.74	2.54
22	3	2.43	7.90E-03	0.09	2.63E-03	-	-	6.45	0.37

Raw data plot for Mn in QC03LH3



Consensus mean plot for Mn in QC03LH3



Replicates

Laboratory Mean

Consensus Mean

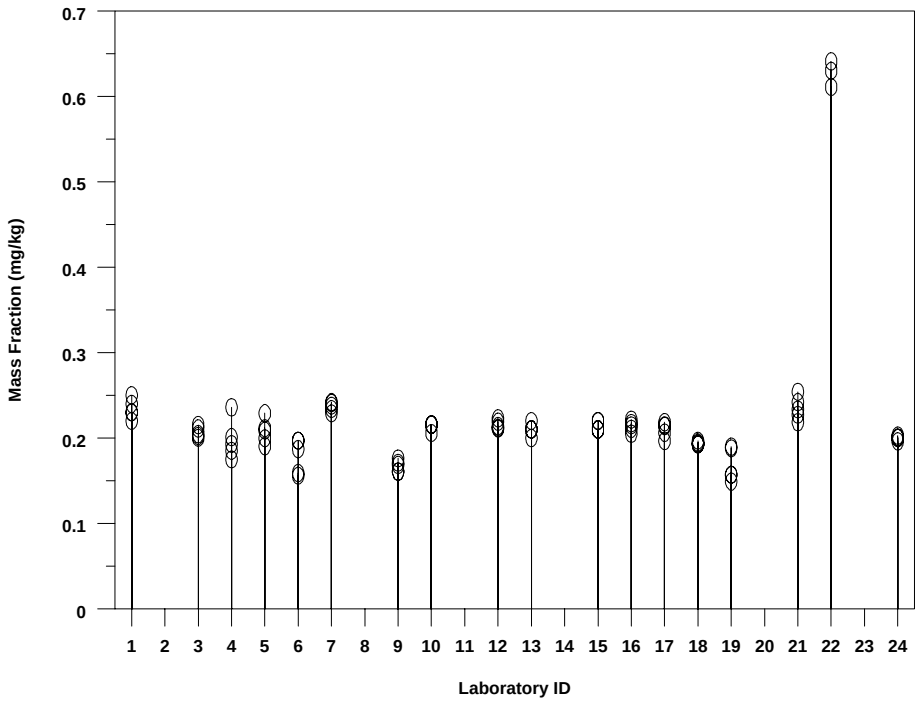
Consensus Mean 95% C.L.

Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Mo	**0.210**	**0.202**	**0.219**	**mg/kg**

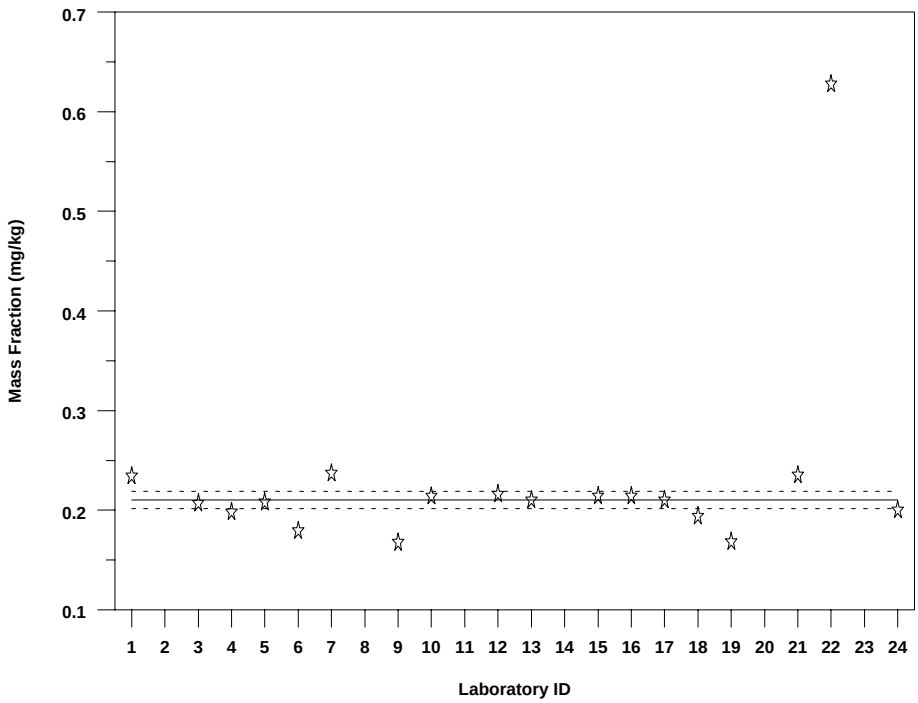
Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.234	1.30E-04	0.011	2.60E-05	0.912	2.65E-05	1.12	0.49
3	5	0.207	3.92E-05	0.006	7.84E-06	0.972	7.79E-06	-0.18	0.30
4	5	0.198	5.44E-04	0.023	1.09E-04	0.724	1.05E-04	-0.59	1.18
5	5	0.208	2.08E-04	0.014	4.16E-05	0.872	4.03E-05	-0.12	0.69
7	5	0.237	2.87E-05	0.005	5.74E-06	0.979	5.78E-06	1.25	0.23
9	5	0.167	4.53E-05	0.007	9.06E-06	0.966	9.50E-06	-2.05	0.40
10	5	0.214	1.92E-05	0.004	3.84E-06	0.986	3.83E-06	0.16	0.21
12	5	0.216	2.57E-05	0.005	5.14E-06	0.982	5.12E-06	0.25	0.23
13	5	0.210	5.00E-05	0.007	1.00E-05	0.965	9.91E-06	-0.02	0.34
15	5	0.214	3.00E-05	0.005	6.00E-06	0.979	5.97E-06	0.17	0.26
16	5	0.214	3.99E-05	0.006	7.98E-06	0.972	7.93E-06	0.16	0.30
17	5	0.210	7.68E-05	0.009	1.54E-05	0.948	1.52E-05	-0.02	0.42
18	6	0.194	2.93E-06	0.002	4.88E-07	0.998	4.88E-07	-0.79	0.09
21	5	0.235	1.87E-04	0.014	3.73E-05	0.877	3.84E-05	1.17	0.58
24	5	0.200	5.99E-06	0.002	1.20E-06	0.996	1.20E-06	-0.50	0.12
Outliers									
6	5	0.179	0.00041	0.020	8.2E-05	-	-	-1.48	1.13
19	5	0.168	0.000372	0.019	7.43E-05	-	-	-2.01	1.15
23*	5	154	65.06301	8	13	-	-	7307	0.52

*Note: Data for Laboratory 23 not plotted (off scale)

Raw data plot for Mo in QC03LH3



Consensus mean plot for Mo in QC03LH3



Replicates

Laboratory Mean

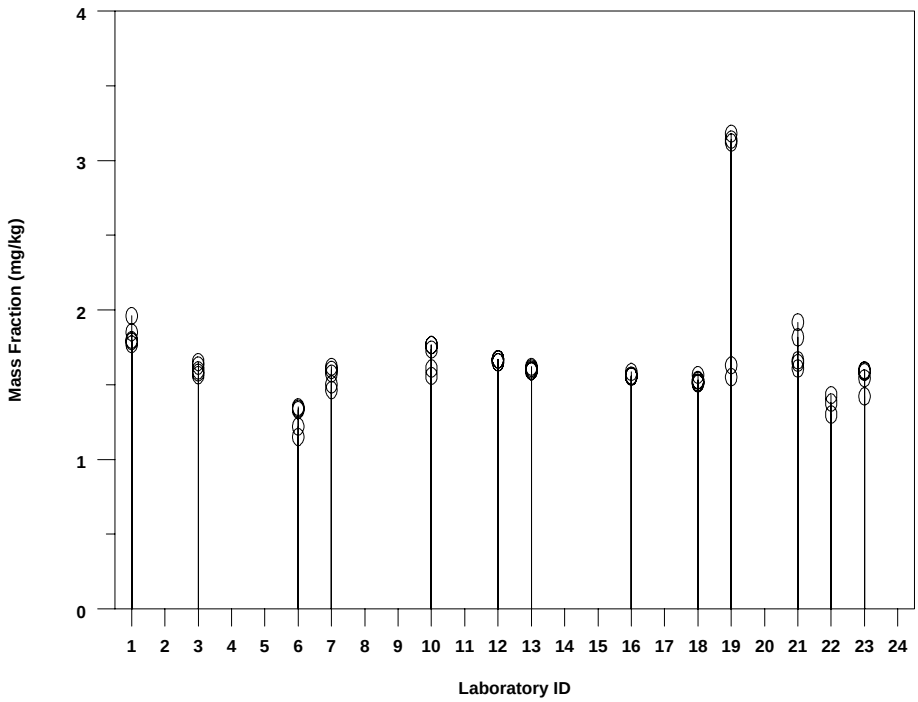
Consensus Mean

Consensus Mean 95% C.L.

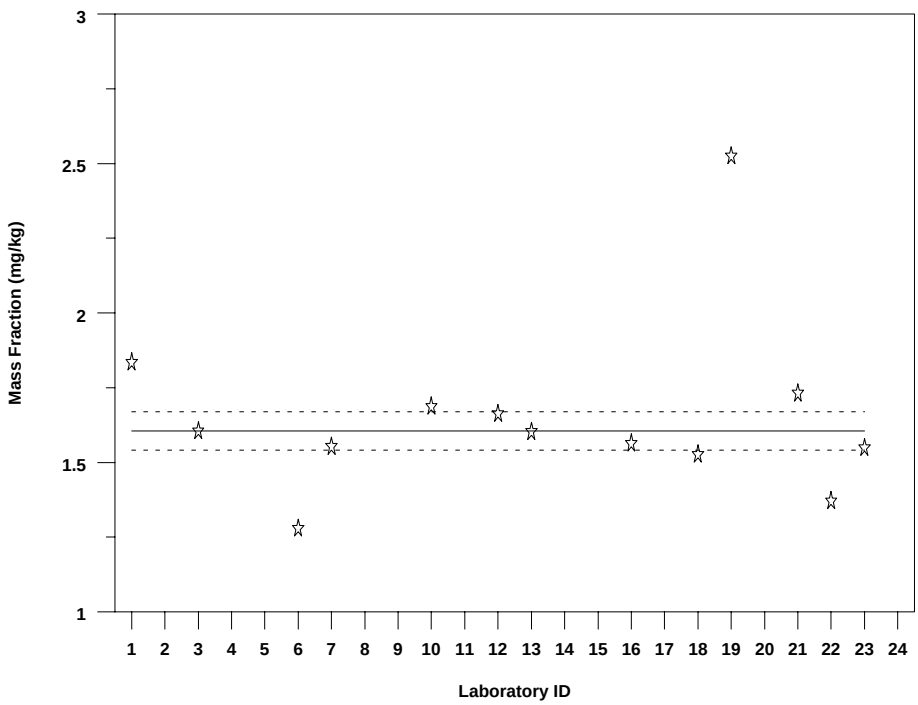
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Rb	**1.61**	**1.54**	**1.67**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	1.83	5.83E-03	0.08	1.17E-03	0.897	1.27E-03	1.43	0.42
3	5	1.60	1.24E-03	0.04	2.49E-04	0.978	2.48E-04	-0.01	0.22
7	5	1.55	4.39E-03	0.07	8.78E-04	0.928	8.66E-04	-0.33	0.43
10	5	1.69	9.28E-03	0.10	1.86E-03	0.859	1.82E-03	0.51	0.57
12	5	1.66	1.20E-04	0.01	2.40E-05	0.998	2.40E-05	0.35	0.07
13	5	1.60	1.70E-04	0.01	3.40E-05	0.997	3.40E-05	-0.02	0.08
16	5	1.56	1.63E-04	0.01	3.27E-05	0.997	3.26E-05	-0.26	0.08
18	6	1.53	4.55E-04	0.02	7.58E-05	0.993	7.57E-05	-0.49	0.14
21	5	1.73	1.73E-02	0.13	3.47E-03	0.761	3.48E-03	0.78	0.76
22	3	1.37	4.30E-03	0.07	1.43E-03	0.856	1.87E-03	-1.46	0.48
23	5	1.55	5.43E-03	0.07	1.09E-03	0.912	1.07E-03	-0.36	0.48
Outliers									
6	5	1.28	7.87E-03	0.09	1.57E-03	-	-	-2.04	0.69
19	5	2.52	7.28E-01	0.85	1.46E-01	-	-	5.73	3.38

Raw data plot for Rb in QC03LH3



Consensus mean plot for Rb in QC03LH3



Replicates

Laboratory Mean

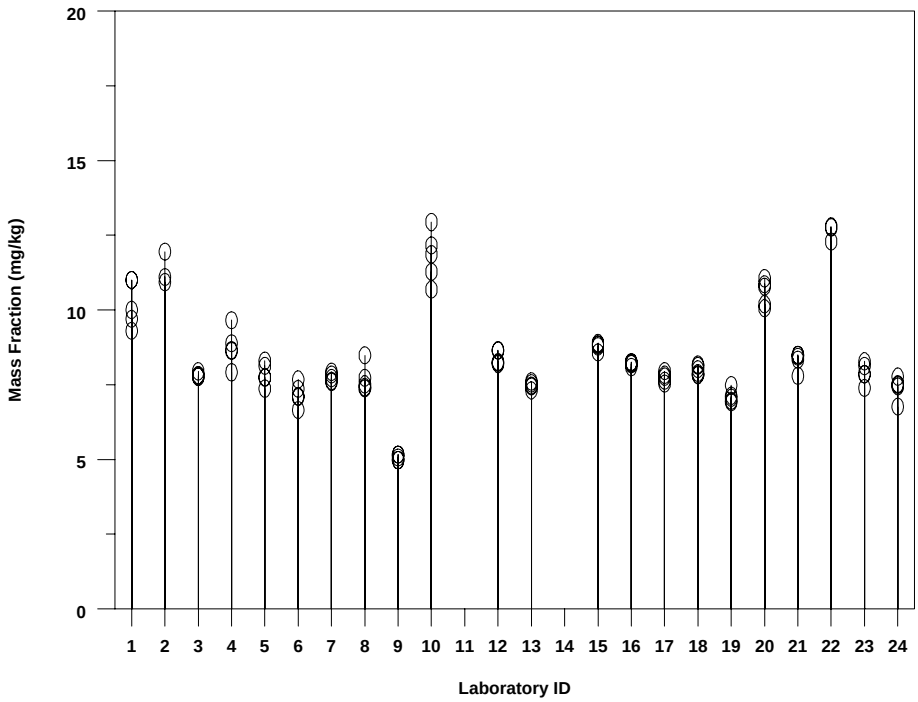
Consensus Mean

Consensus Mean 95% C.L.

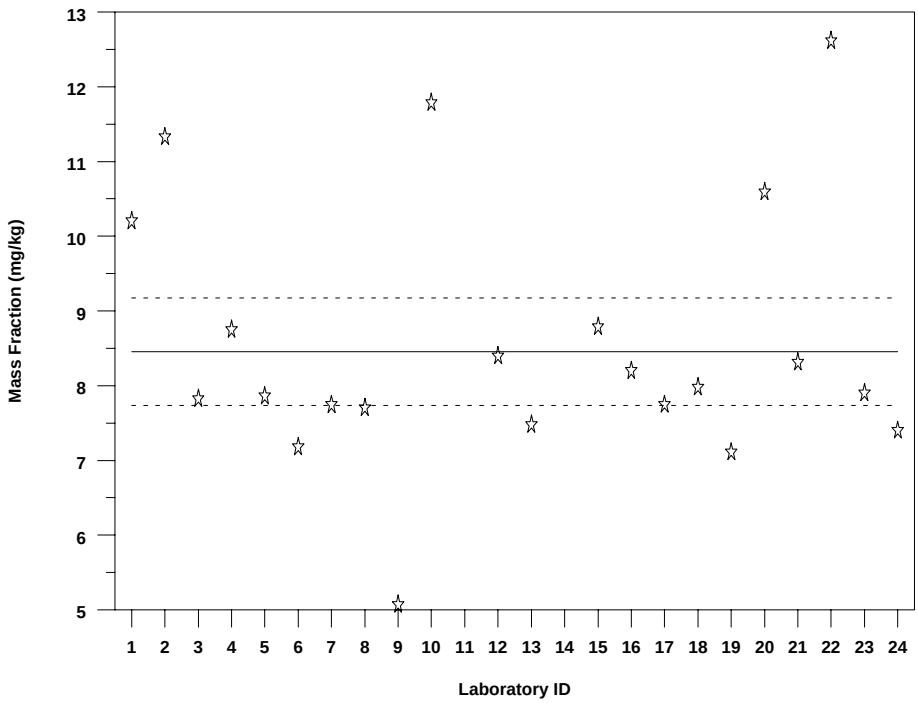
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Se	**8.46**	**7.74**	**9.17**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	10.20	5.95E-01	0.77	1.19E-01	0.957	1.19E-01	2.06	0.76
3	5	7.82	5.18E-03	0.07	1.04E-03	1.000	1.04E-03	-0.75	0.09
4	5	8.75	3.89E-01	0.62	7.79E-02	0.972	7.74E-02	0.34	0.71
5	5	7.86	1.35E-01	0.37	2.69E-02	0.990	2.69E-02	-0.71	0.47
7	5	7.74	2.01E-02	0.14	4.01E-03	0.998	4.01E-03	-0.84	0.18
8	5	7.70	2.08E-01	0.46	4.16E-02	0.985	4.15E-02	-0.89	0.59
9	5	5.07	8.61E-03	0.09	1.72E-03	0.999	1.72E-03	-4.01	0.18
10	5	11.78	7.37E-01	0.86	1.47E-01	0.945	1.54E-01	3.94	0.73
12	5	8.39	5.31E-02	0.23	1.06E-02	0.996	1.06E-02	-0.07	0.27
13	5	7.48	1.31E-02	0.11	2.61E-03	0.999	2.61E-03	-1.16	0.15
15	5	8.79	1.48E-02	0.12	2.97E-03	0.999	2.97E-03	0.39	0.14
16	5	8.20	4.28E-03	0.07	8.56E-04	1.000	8.56E-04	-0.31	0.08
17	5	7.74	2.66E-02	0.16	5.32E-03	0.998	5.31E-03	-0.84	0.21
18	6	7.98	2.27E-02	0.15	3.78E-03	0.999	3.78E-03	-0.57	0.19
19	5	7.11	5.06E-02	0.22	1.01E-02	0.996	1.01E-02	-1.59	0.32
20	5	10.59	1.93E-01	0.44	3.85E-02	0.986	3.86E-02	2.52	0.41
21	5	8.31	8.80E-02	0.30	1.76E-02	0.993	1.76E-02	-0.17	0.36
22	3	12.61	7.86E-02	0.28	2.62E-02	0.990	2.69E-02	4.92	0.22
23	5	7.90	1.14E-01	0.34	2.28E-02	0.992	2.27E-02	-0.66	0.43
24	5	7.40	1.41E-01	0.38	2.81E-02	0.990	2.81E-02	-1.25	0.51
Outliers									
2	3	11.33	2.99E-01	0.55	9.95E-02	-	-	3.39	0.48
6	5	7.18	1.42E-01	0.38	2.83E-02	-	-	-1.51	0.52

Raw data plot for Se in QC03LH3



Consensus mean plot for Se in QC03LH3



Replicates

Laboratory Mean

Consensus Mean

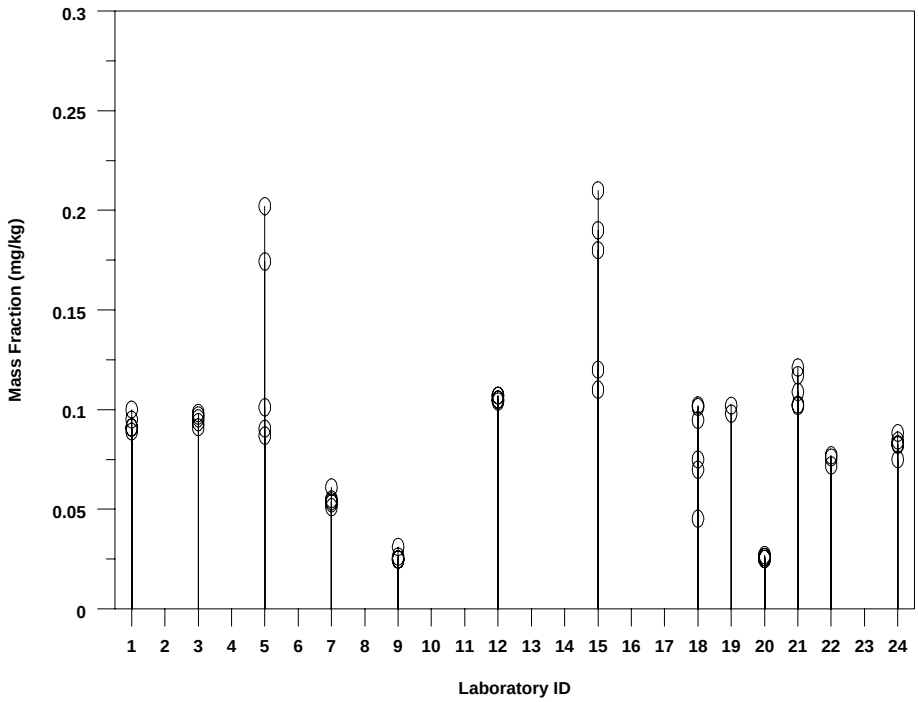
Consensus Mean 95% C.L.

Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Sn	**0.080**	**0.063**	**0.097**	**mg/kg**

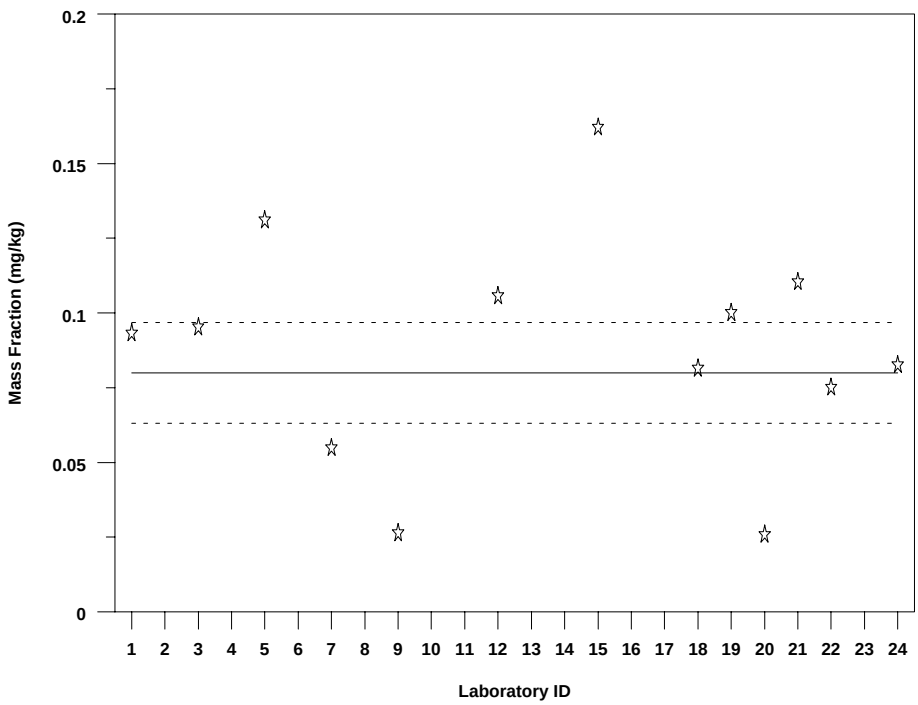
Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.093	1.92E-05	4.38E-03	3.84E-06	0.995	3.84E-06	1.67	0.47
3	5	0.095	7.91E-06	2.81E-03	1.58E-06	0.998	1.58E-06	1.91	0.30
5	5	0.131	2.85E-03	5.34E-02	5.71E-04	0.576	6.22E-04	6.39	4.08
7	5	0.055	1.42E-05	3.77E-03	2.84E-06	0.997	2.84E-06	-3.14	0.69
9	5	0.026	7.47E-06	2.73E-03	1.49E-06	0.998	1.49E-06	-6.71	1.04
12	5	0.106	1.80E-06	1.34E-03	3.60E-07	1.000	3.60E-07	3.22	0.13
18	6	0.081	4.97E-04	2.23E-02	8.29E-05	0.912	8.15E-05	0.19	2.74
19	2	0.100	8.00E-06	2.83E-03	4.00E-06	0.995	3.99E-06	2.52	0.28
20	5	0.026	7.00E-07	8.37E-04	1.40E-07	1.000	1.40E-07	-6.77	0.32
21	5	0.110	7.52E-05	8.67E-03	1.50E-05	0.982	1.51E-05	3.81	0.79
22	3	0.075	7.00E-06	2.65E-03	2.33E-06	0.997	2.33E-06	-0.61	0.35
24	5	0.083	2.35E-05	4.85E-03	4.70E-06	0.994	4.69E-06	0.33	0.59
Outliers									
15	5	0.162	1.97E-03	4.44E-02	3.94E-04	-	-	10.28	2.74
23*	5	10.23	0.79	0.89	0.16	-	-	1270	0.87

*Note: Data for Laboratory 23 not plotted (off scale)

Raw data plot for Sn in QC03LH3



Consensus mean plot for Sn in QC03LH3



Replicates

Laboratory Mean

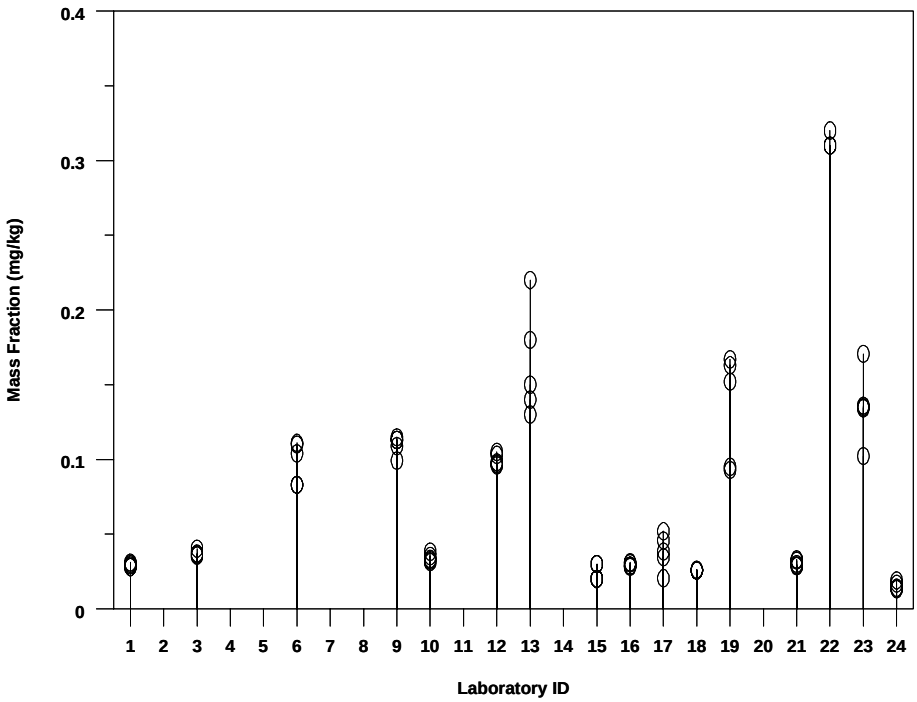
Consensus Mean

Consensus Mean 95% C.L.

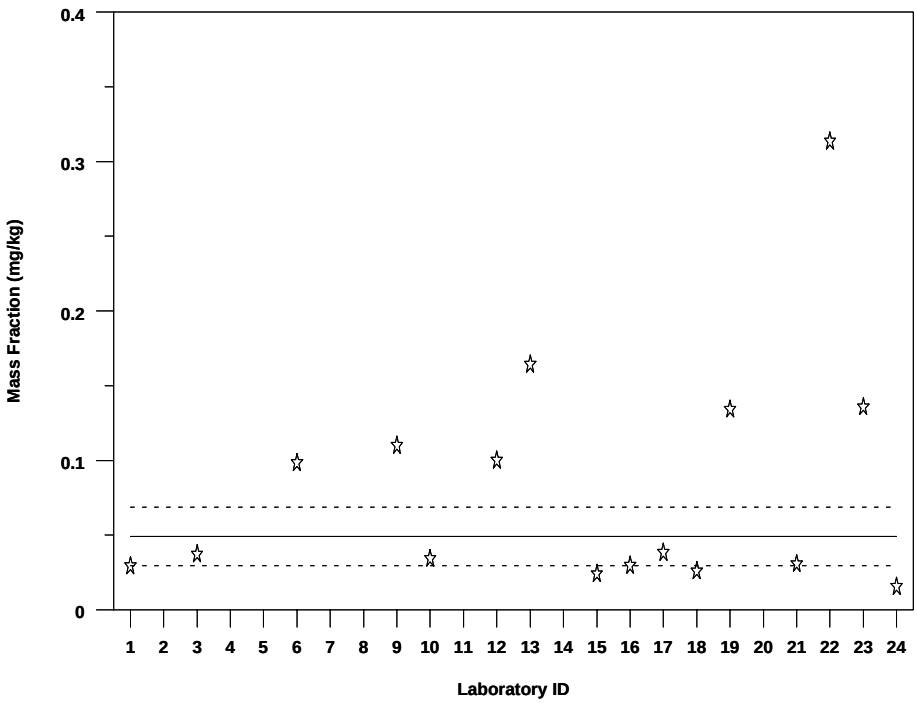
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
V	0.049	0.030	0.069	mg/kg

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	0.029	1.70E-06	1.30E-03	3.40E-07	1.000	3.40E-07	-4.06	0.45
3	5	0.037	3.33E-06	1.82E-03	6.66E-07	0.999	6.66E-07	-2.45	0.49
6	5	0.098	2.00E-04	1.41E-02	3.99E-05	0.964	4.03E-05	9.99	1.44
9	5	0.110	3.97E-05	6.30E-03	7.93E-06	0.993	7.97E-06	12.35	0.57
10	5	0.034	7.40E-06	2.72E-03	1.48E-06	0.999	1.48E-06	-3.05	0.80
12	5	0.100	1.57E-05	3.96E-03	3.14E-06	0.997	3.14E-06	10.32	0.40
15	5	0.024	3.00E-05	5.48E-03	6.00E-06	0.995	6.00E-06	-5.11	2.28
17	5	0.038	1.43E-04	1.20E-02	2.87E-05	0.975	2.85E-05	-2.22	3.13
18	6	0.026	2.69E-08	1.64E-04	4.48E-09	1.000	4.48E-09	-4.73	0.06
21	5	0.031	3.83E-06	1.96E-03	7.67E-07	0.999	7.67E-07	-3.78	0.64
24	5	0.015	6.29E-06	2.51E-03	1.26E-06	0.999	1.26E-06	-6.87	1.63
Outliers									
13	5	0.164	1.33E-03	3.65E-02	2.66E-04	-	-	23.38	2.22
16	5	0.029	1.59E-06	1.26E-03	3.18E-07	-	-	-4.00	0.43
19	5	0.134	1.36E-03	3.69E-02	2.73E-04	-	-	17.28	2.76
22	3	0.313	3.33E-05	5.77E-03	1.11E-05	-	-	53.78	0.18
23	5	0.136	5.86E-04	2.42E-02	1.17E-04	-	-	17.60	1.79

Raw data plot for V in QC03LH3



Consensus mean plot for V in QC03LH3



Replicates

Laboratory Mean

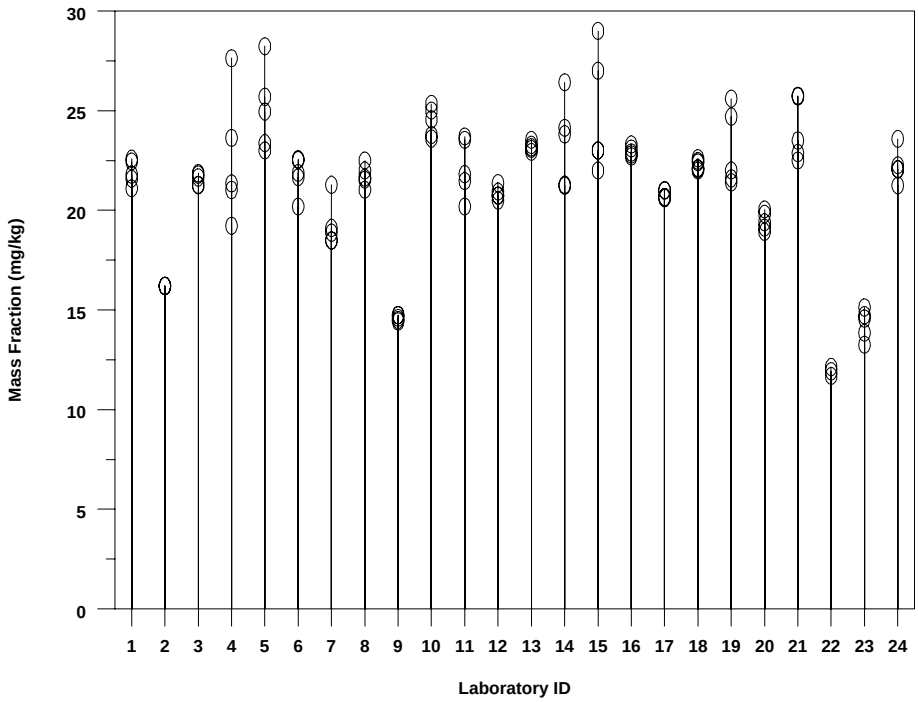
Consensus Mean

Consensus Mean 95% C.L.

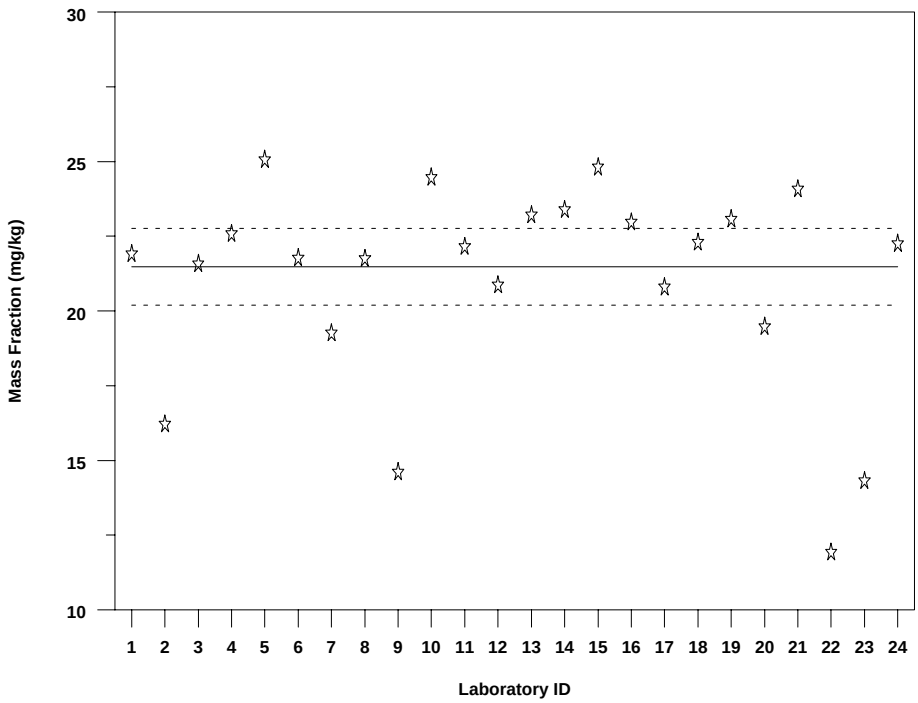
Element	Consensus Mean	Lower 95% C.L.	Upper 95% C.L.	Units
Zn	**21.48**	**20.19**	**22.77**	**mg/kg**

Lab. #	N	Laboratory Mean	Variance	Standard Deviation	Variance of mean	ML Weight	Tau Estimate	z-score	p-score
1	5	21.90	3.80E-01	0.62	7.60E-02	0.992	7.58E-02	0.20	0.28
3	5	21.57	8.12E-02	0.29	1.62E-02	0.998	1.62E-02	0.04	0.13
4	5	22.57	1.05E+01	3.23	2.09E+00	0.820	2.01E+00	0.51	1.43
5	5	25.05	4.39E+00	2.09	8.78E-01	0.912	8.83E-01	1.66	0.84
6	5	21.76	9.26E-01	0.96	1.85E-01	0.980	1.84E-01	0.13	0.44
7	5	19.25	1.36E+00	1.17	2.72E-01	0.971	2.71E-01	-1.04	0.61
8	5	21.74	3.00E-01	0.55	6.01E-02	0.993	6.00E-02	0.12	0.25
9	5	14.60	2.04E-02	0.14	4.08E-03	1.000	4.08E-03	-3.20	0.10
10	5	24.46	5.70E-01	0.75	1.14E-01	0.988	1.14E-01	1.39	0.31
11	5	22.14	2.19E+00	1.48	4.38E-01	0.955	4.33E-01	0.31	0.67
12	5	20.85	1.06E-01	0.33	2.12E-02	0.998	2.12E-02	-0.29	0.16
13	5	23.20	5.27E-02	0.23	1.05E-02	0.999	1.05E-02	0.80	0.10
14	5	23.38	4.76E+00	2.18	9.52E-01	0.907	9.38E-01	0.88	0.93
15	5	24.80	9.20E+00	3.03	1.84E+00	0.833	1.84E+00	1.55	1.22
16	5	22.96	5.80E-02	0.24	1.16E-02	0.999	1.16E-02	0.69	0.10
17	5	20.78	3.97E-02	0.20	7.93E-03	0.999	7.93E-03	-0.32	0.10
18	6	22.28	6.15E-02	0.25	1.02E-02	0.999	1.02E-02	0.37	0.11
19	5	23.06	3.79E+00	1.95	7.58E-01	0.925	7.47E-01	0.74	0.84
20	5	19.46	2.18E-01	0.47	4.35E-02	0.995	4.35E-02	-0.94	0.24
21	5	24.07	2.44E+00	1.56	4.87E-01	0.950	4.85E-01	1.20	0.65
22	3	11.91	4.84E-02	0.22	1.61E-02	0.998	1.63E-02	-4.45	0.18
24	5	22.24	7.11E-01	0.84	1.42E-01	0.985	1.42E-01	0.35	0.38
Outliers									
2	3	16.20	5.68E-14	0.00	1.89E-14	-	-	-2.46	0.00
23	5	14.31	5.61E-01	0.75	1.12E-01	-	-	-3.34	0.52

Raw data plot for Zn in QC03LH3



Consensus mean plot for Zn in QC03LH3



Replicates

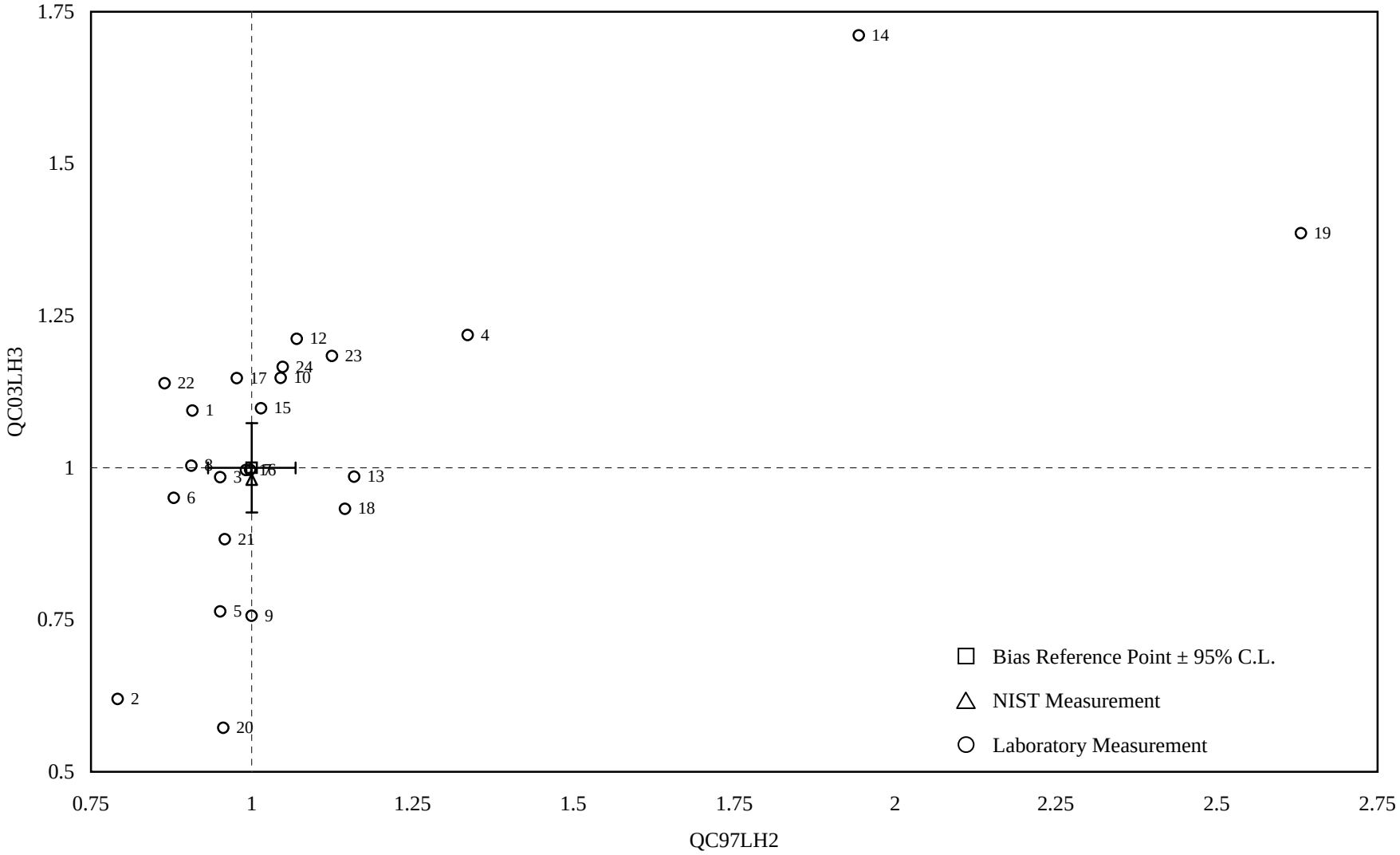
Laboratory Mean

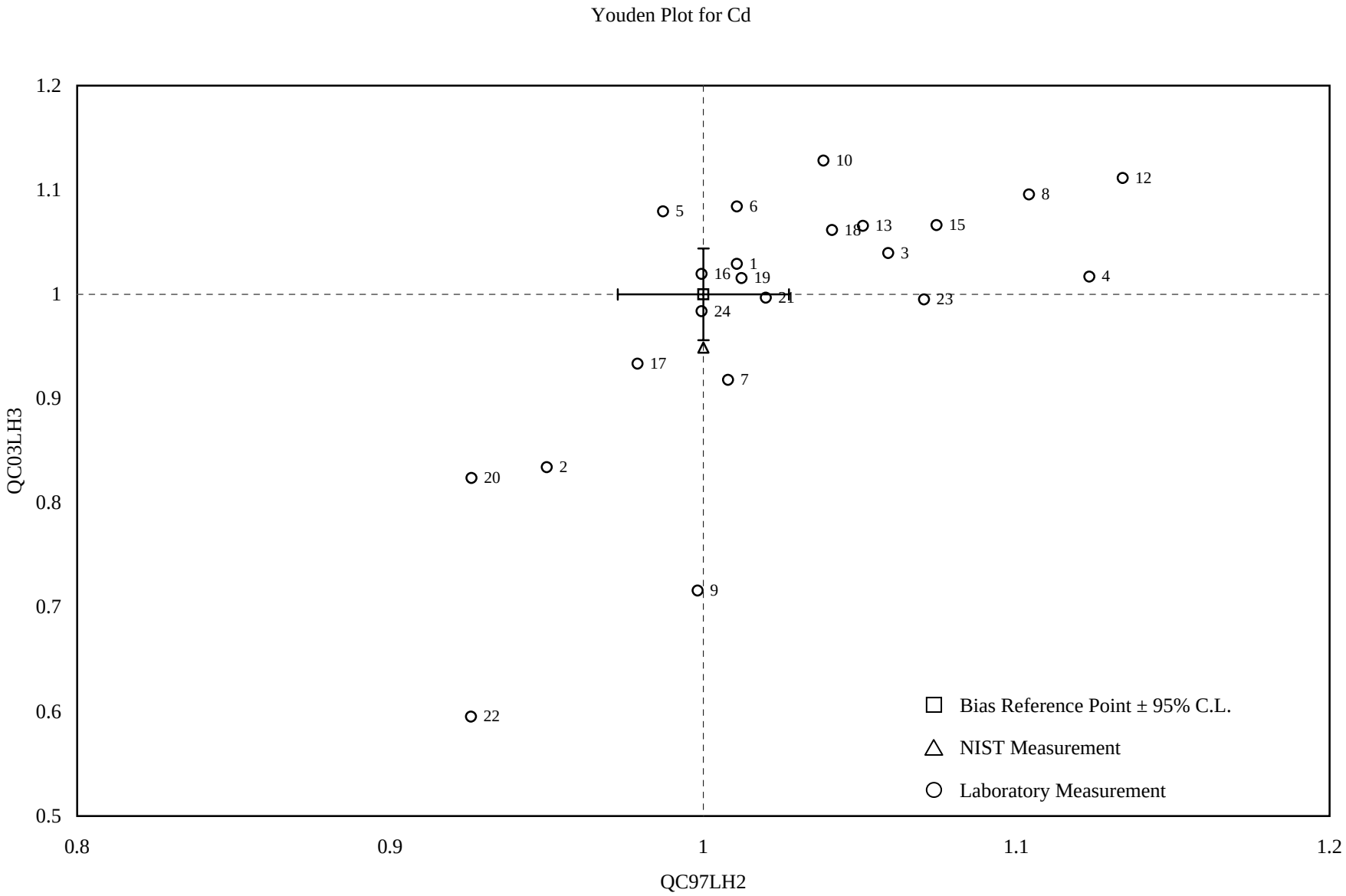
Consensus Mean

Consensus Mean 95% C.L.

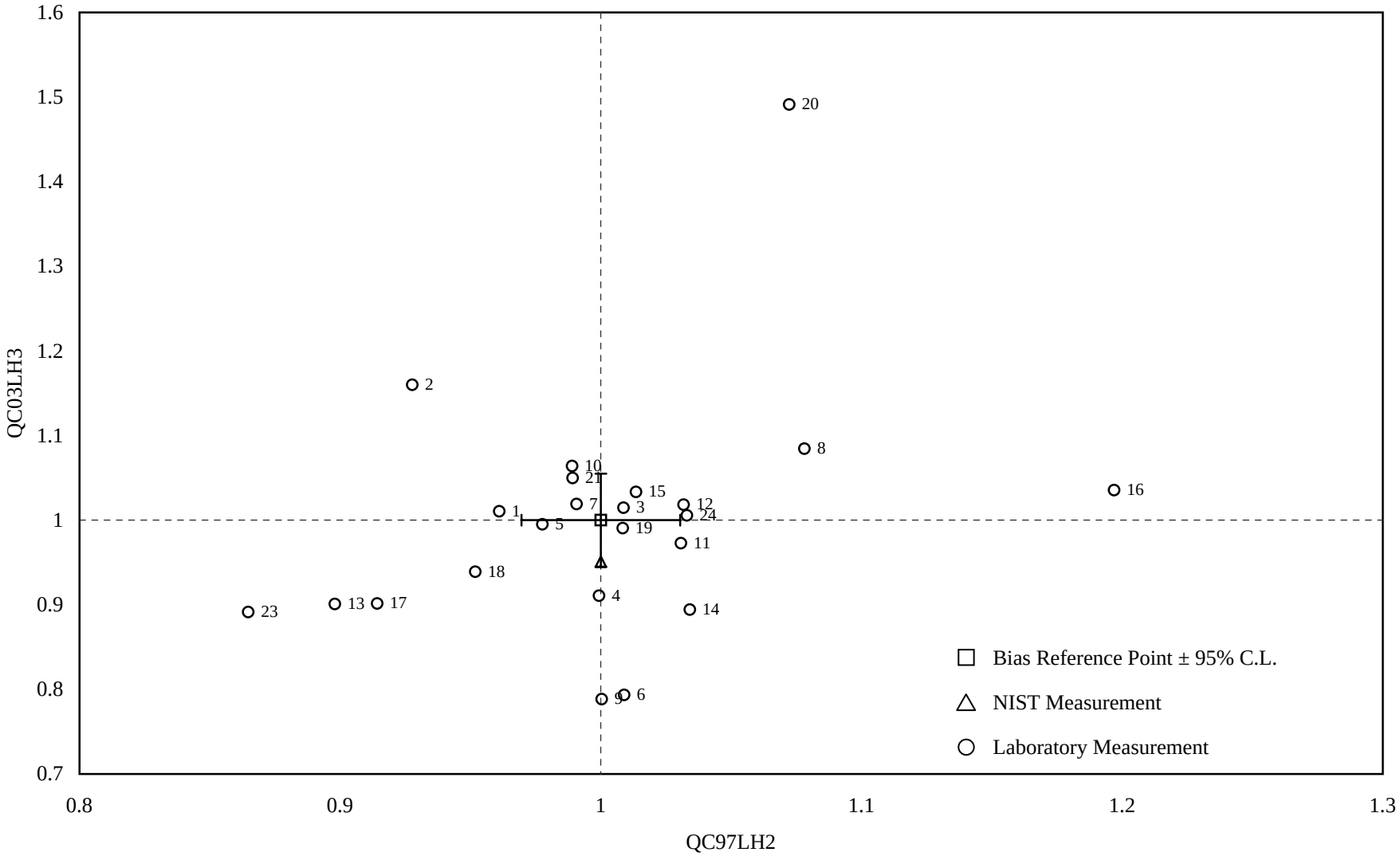
Appendix D: Youden Plots

Youden Plot for As

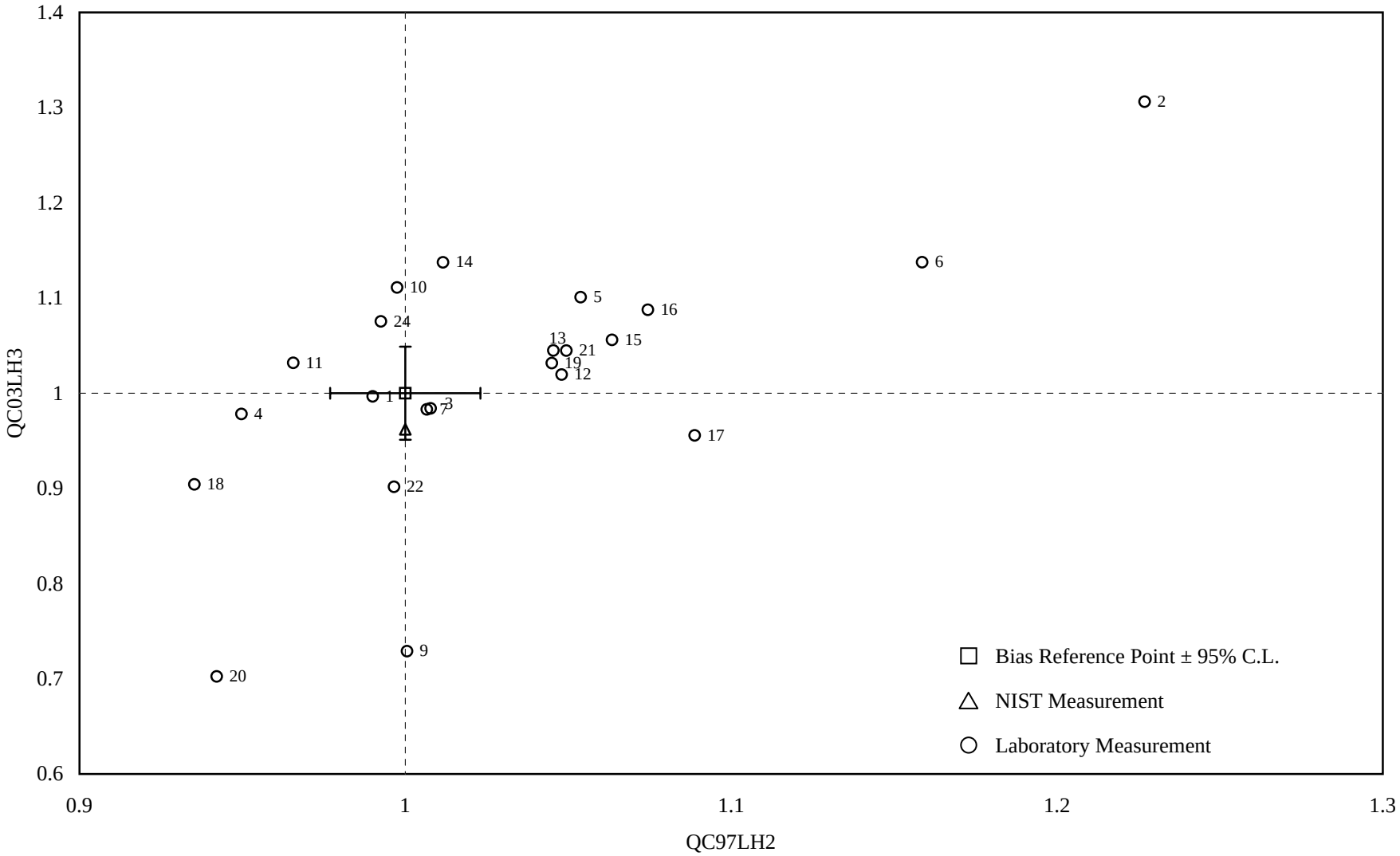


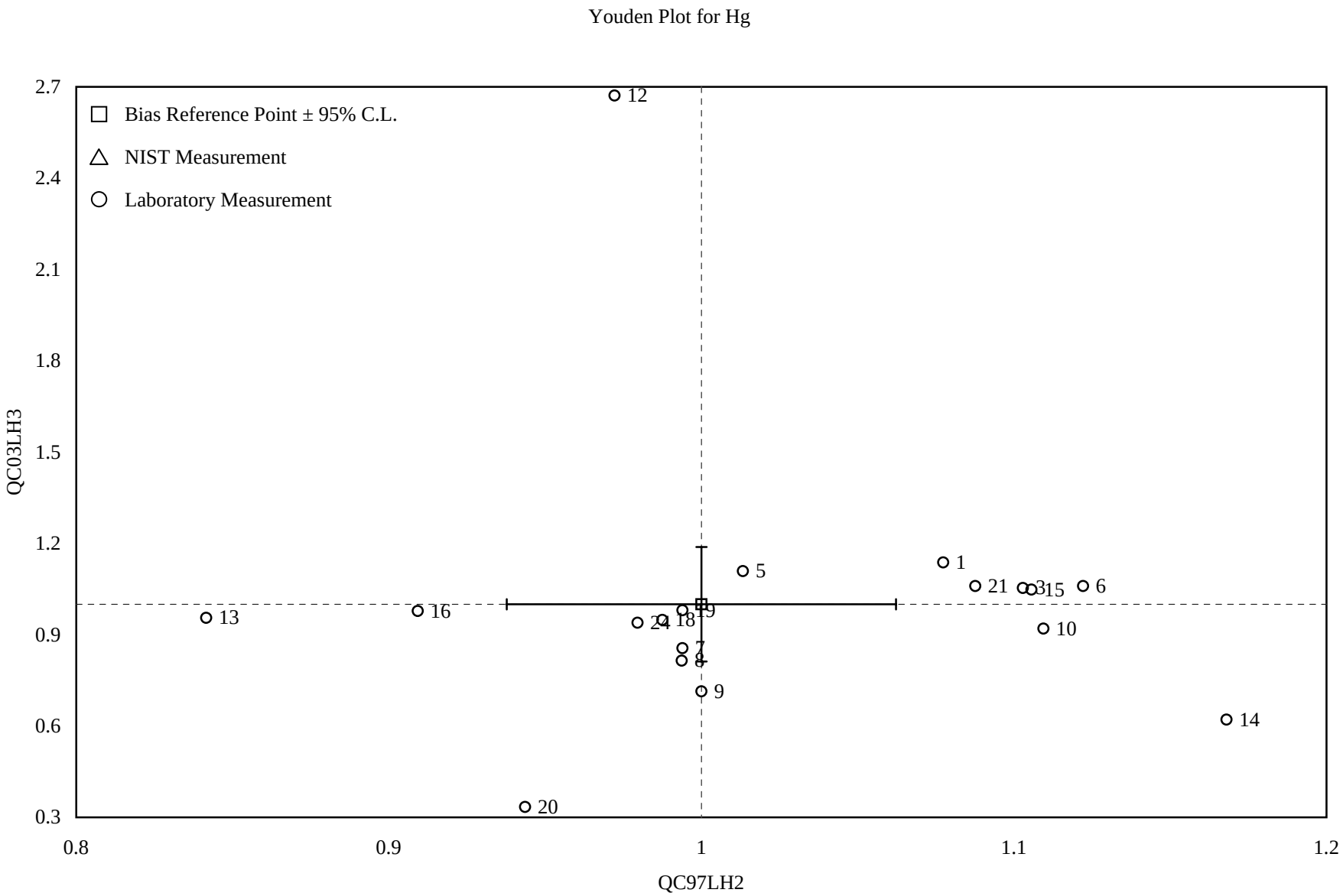

Youden Plot for Cd
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
QC03LH3
0.8
0.9
1
1.1
1.2
QC97LH2
10
12
8
5
6
18
13
15
3
1
16
19
4
21
23
24
17
7
20
2
9
22
Bias Reference Point ± 95% C.L.
NIST Measurement
Laboratory Measurement

Youden Plot for Cu

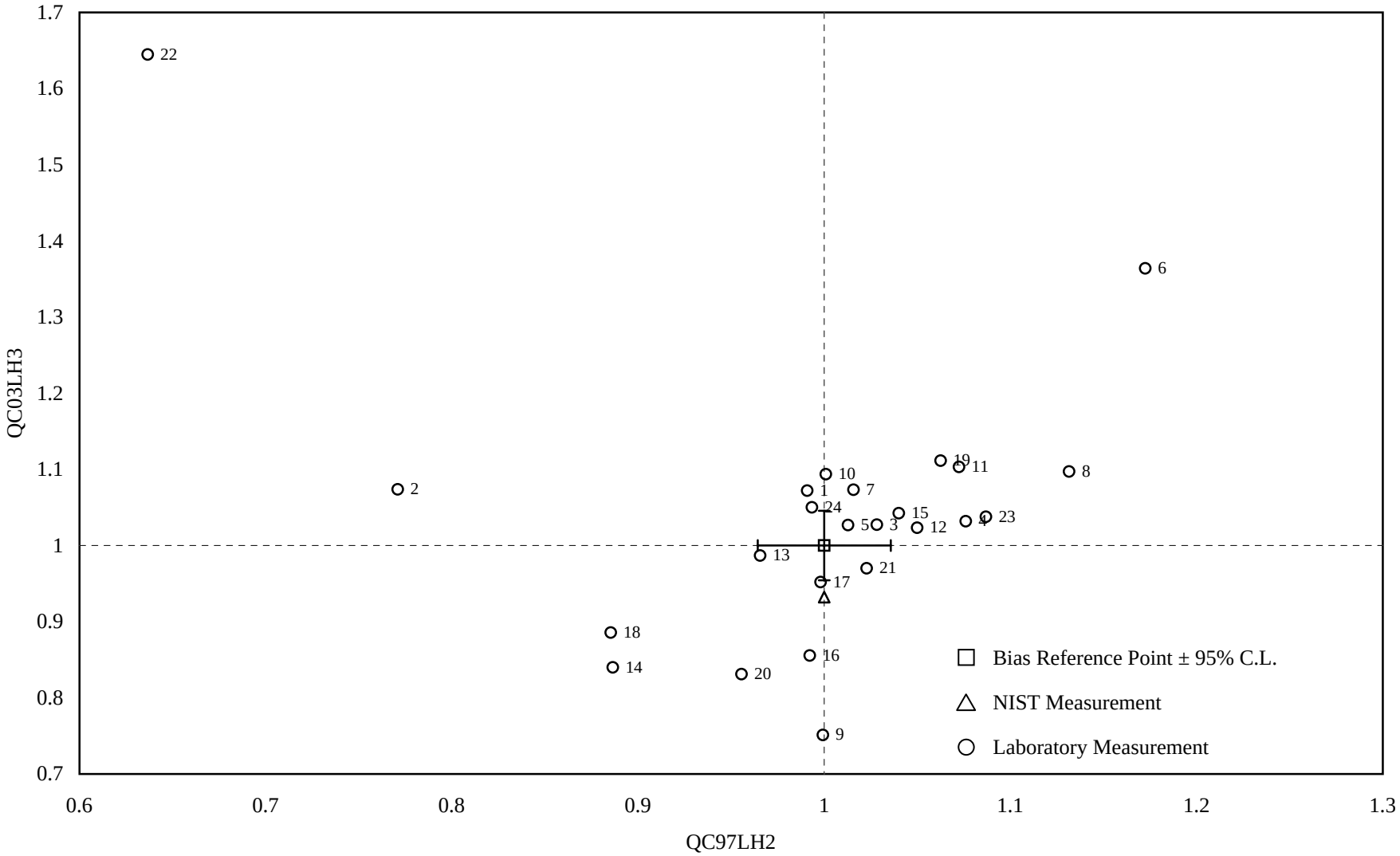


Youden Plot for Fe

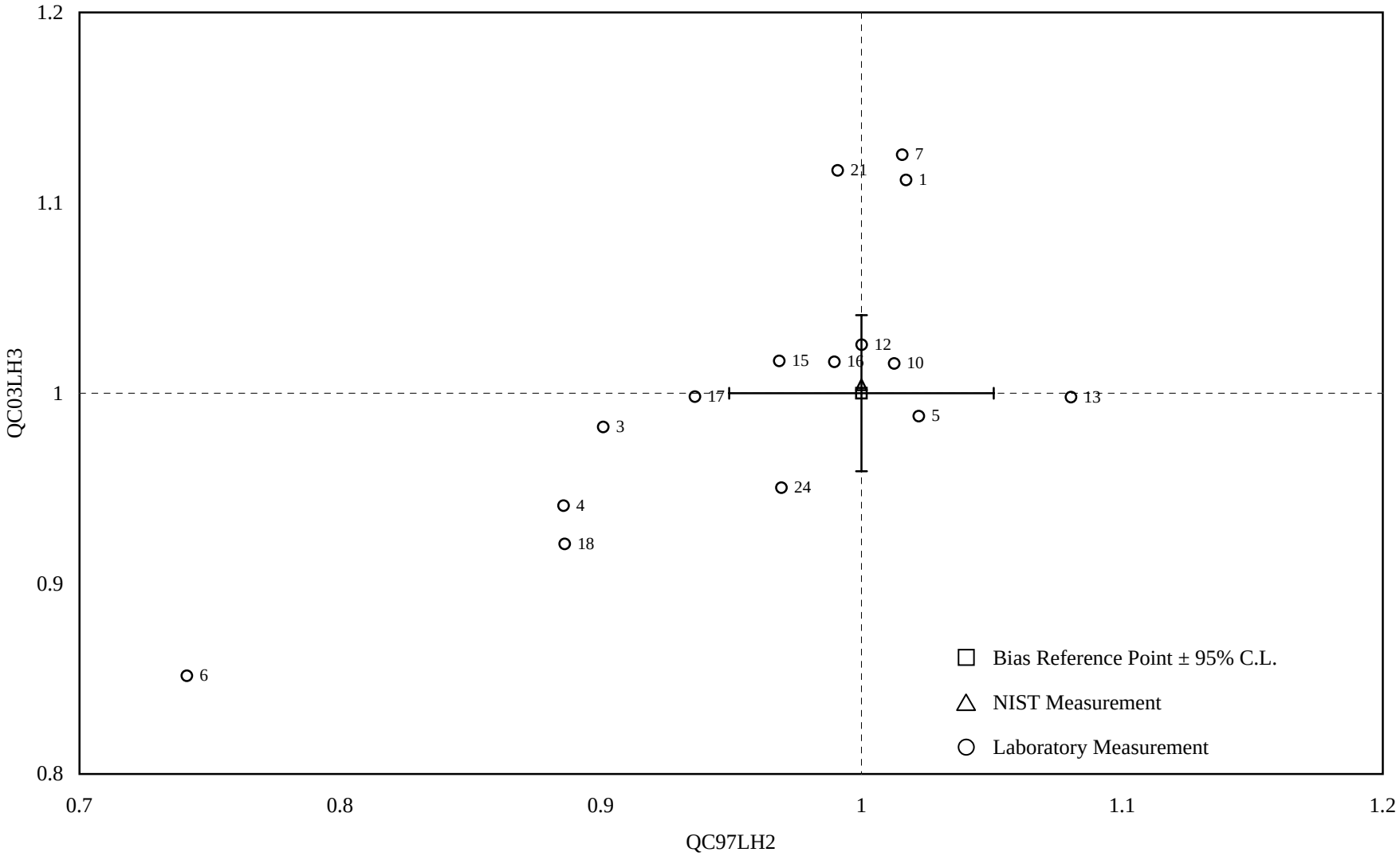



Youden Plot for Hg
Bias Reference Point ± 95% C.L.
NIST Measurement
Laboratory Measurement
QC03LH3
QC97LH2
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.8
0.9
1
1.1
1.2
12
5
1
21
3
15
6
13
16
24
18
19
10
7
8
9
14
20

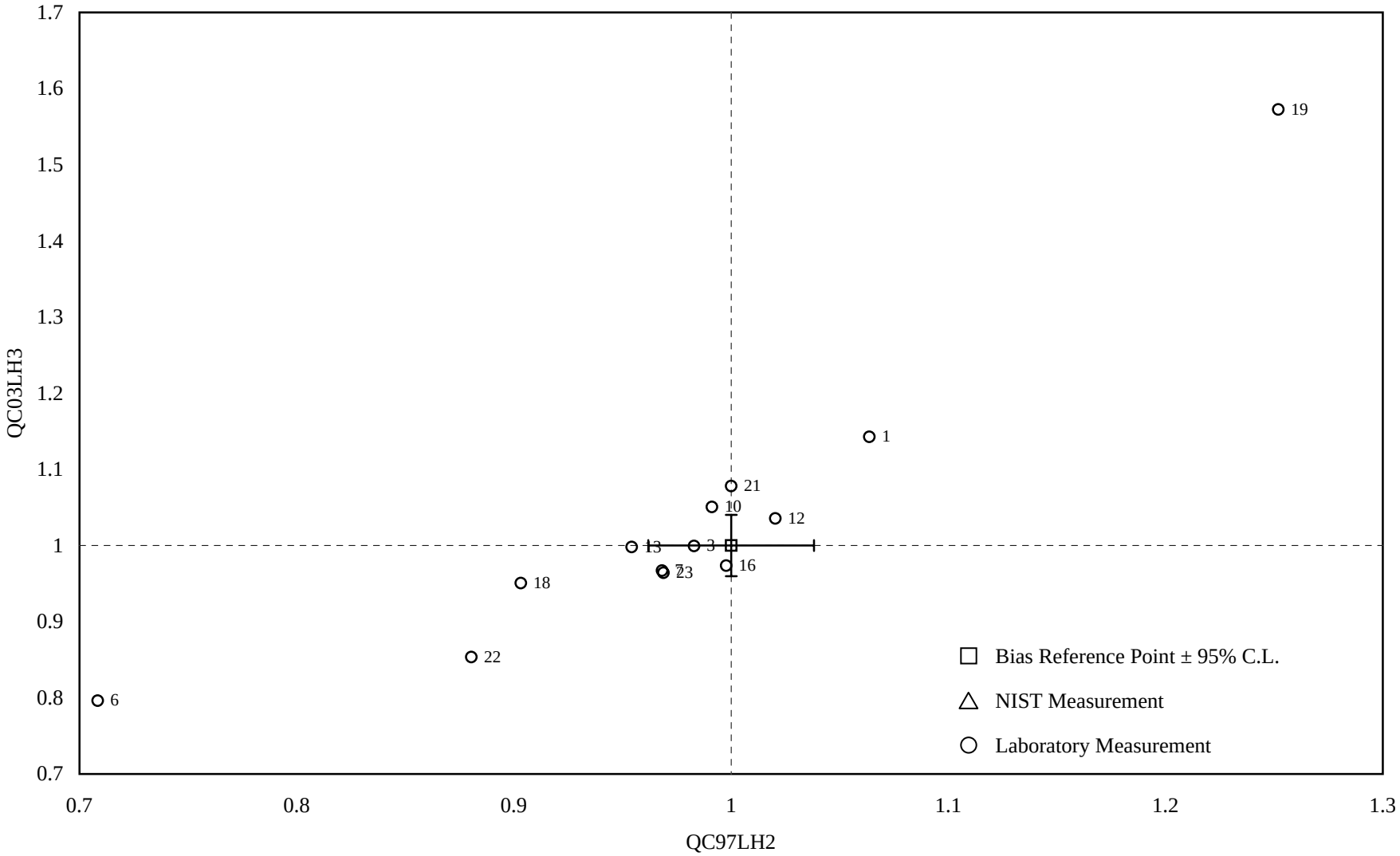
Youden Plot for Mn



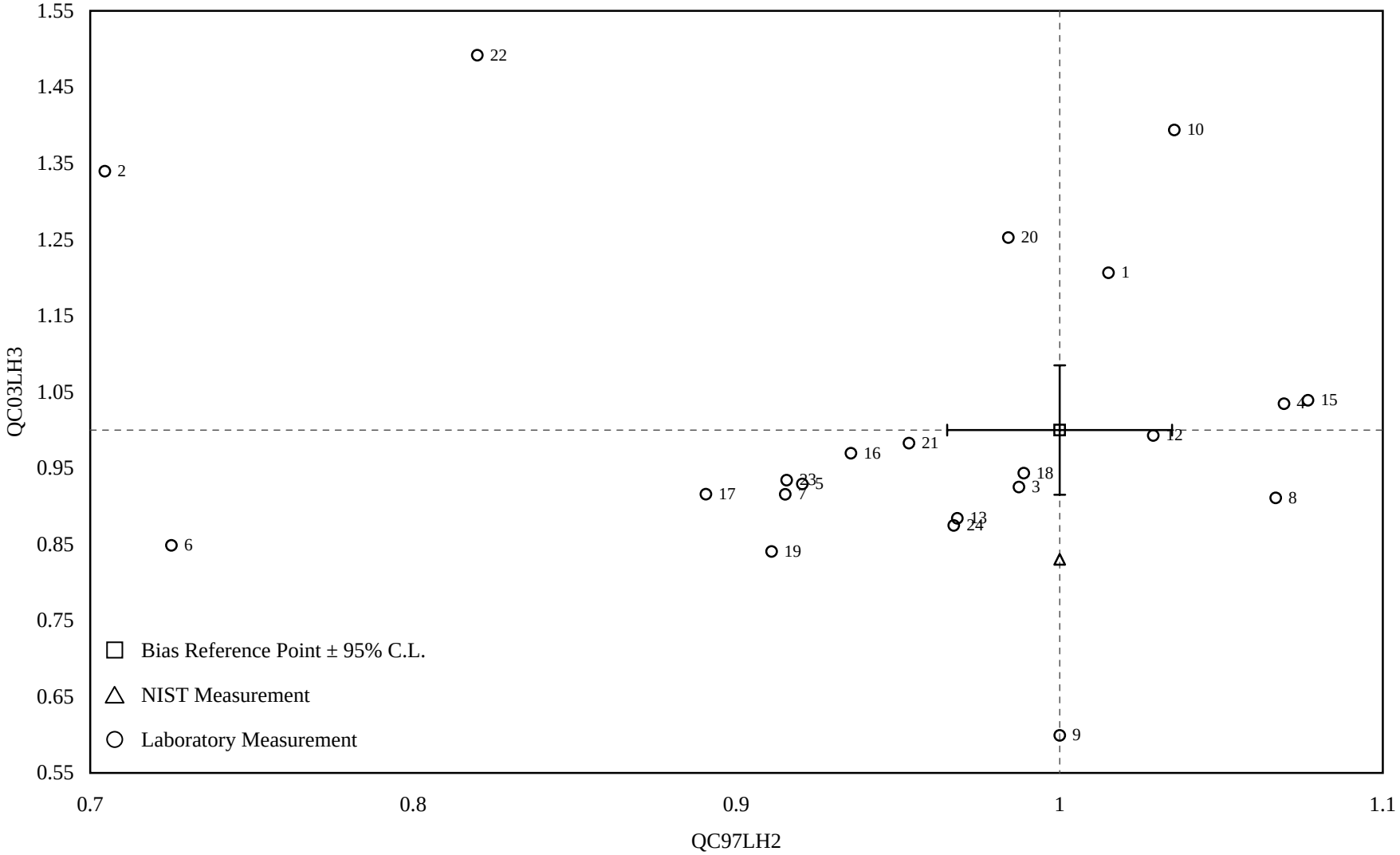
Youden Plot for Mo



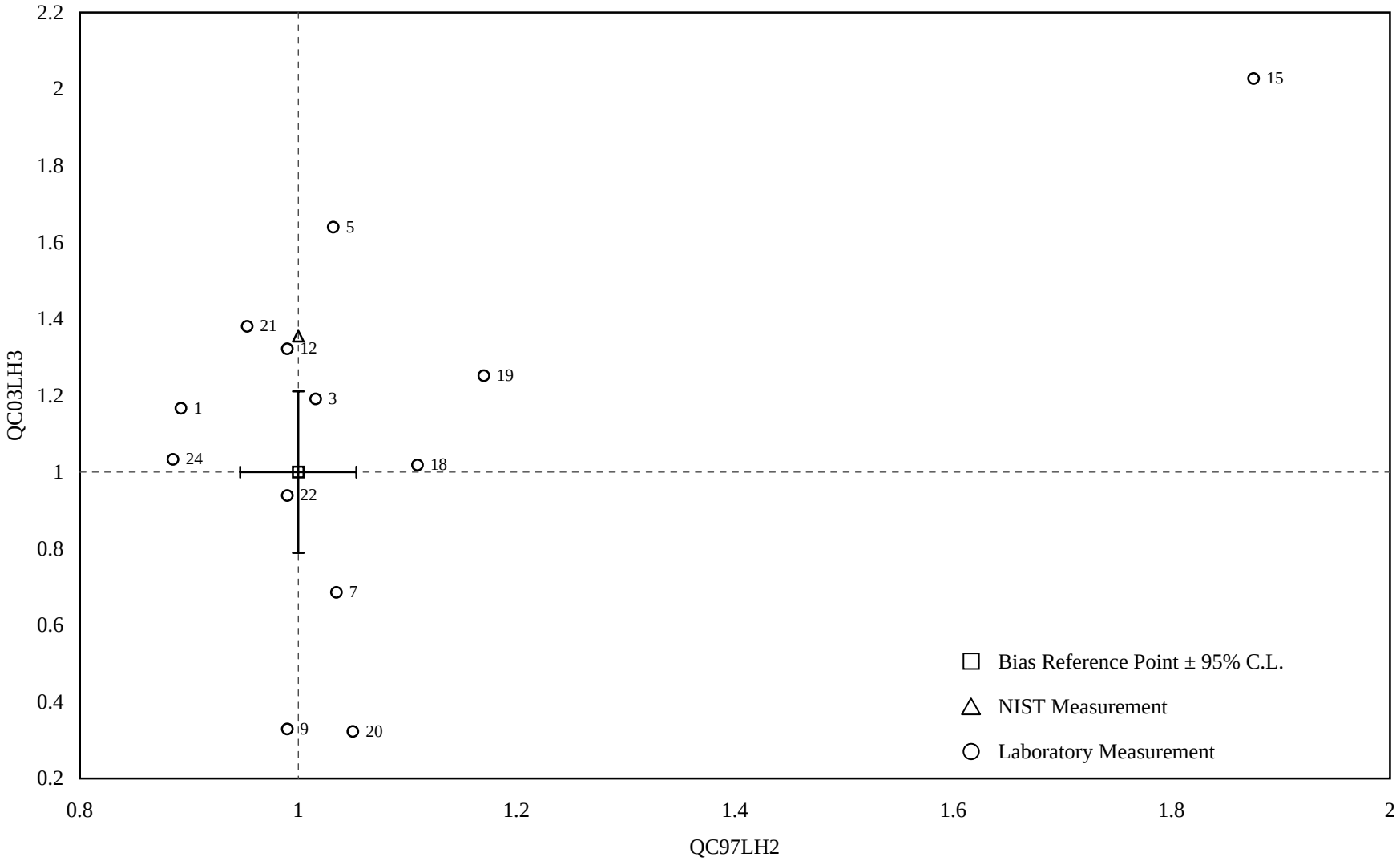
Youden Plot for Rb

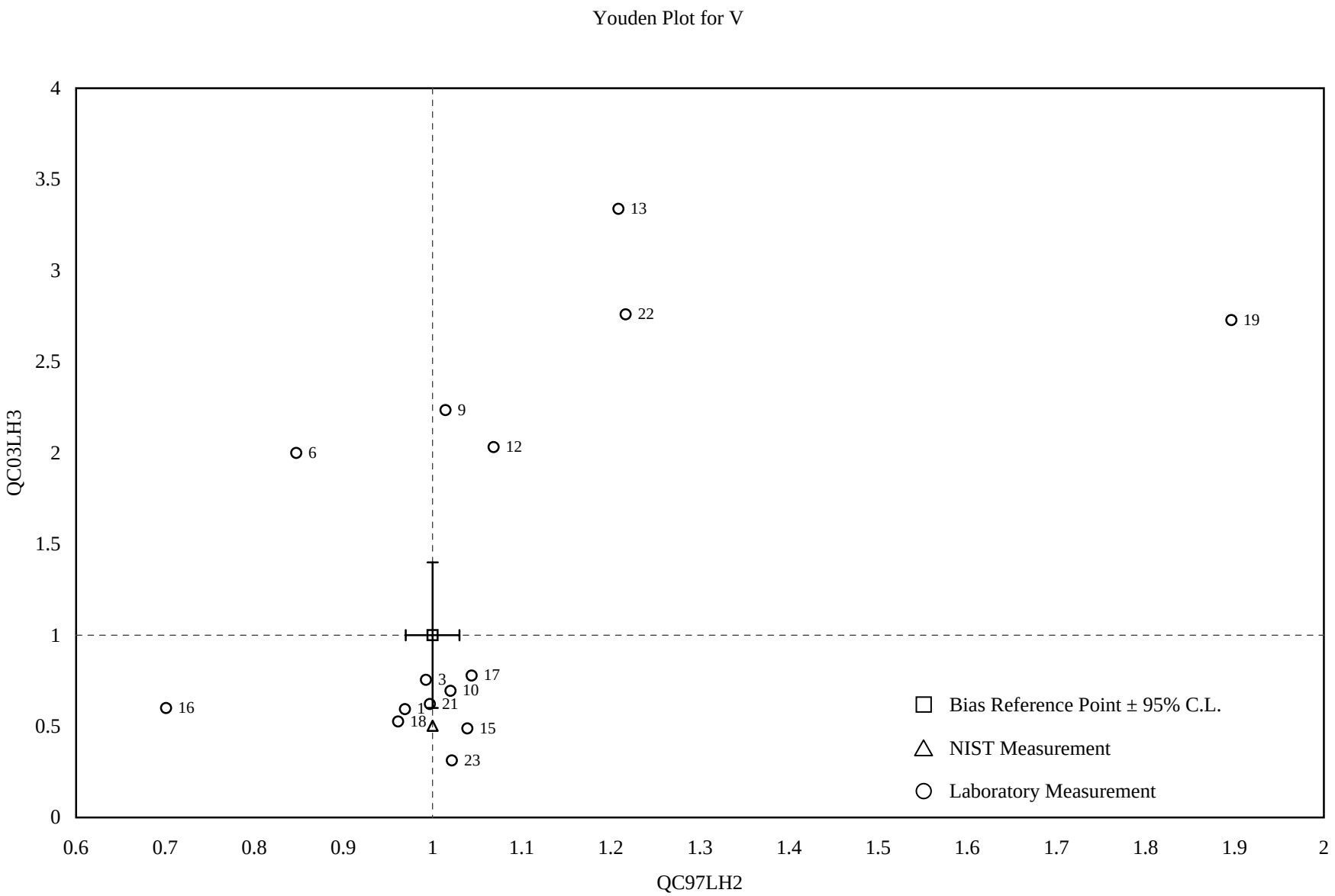


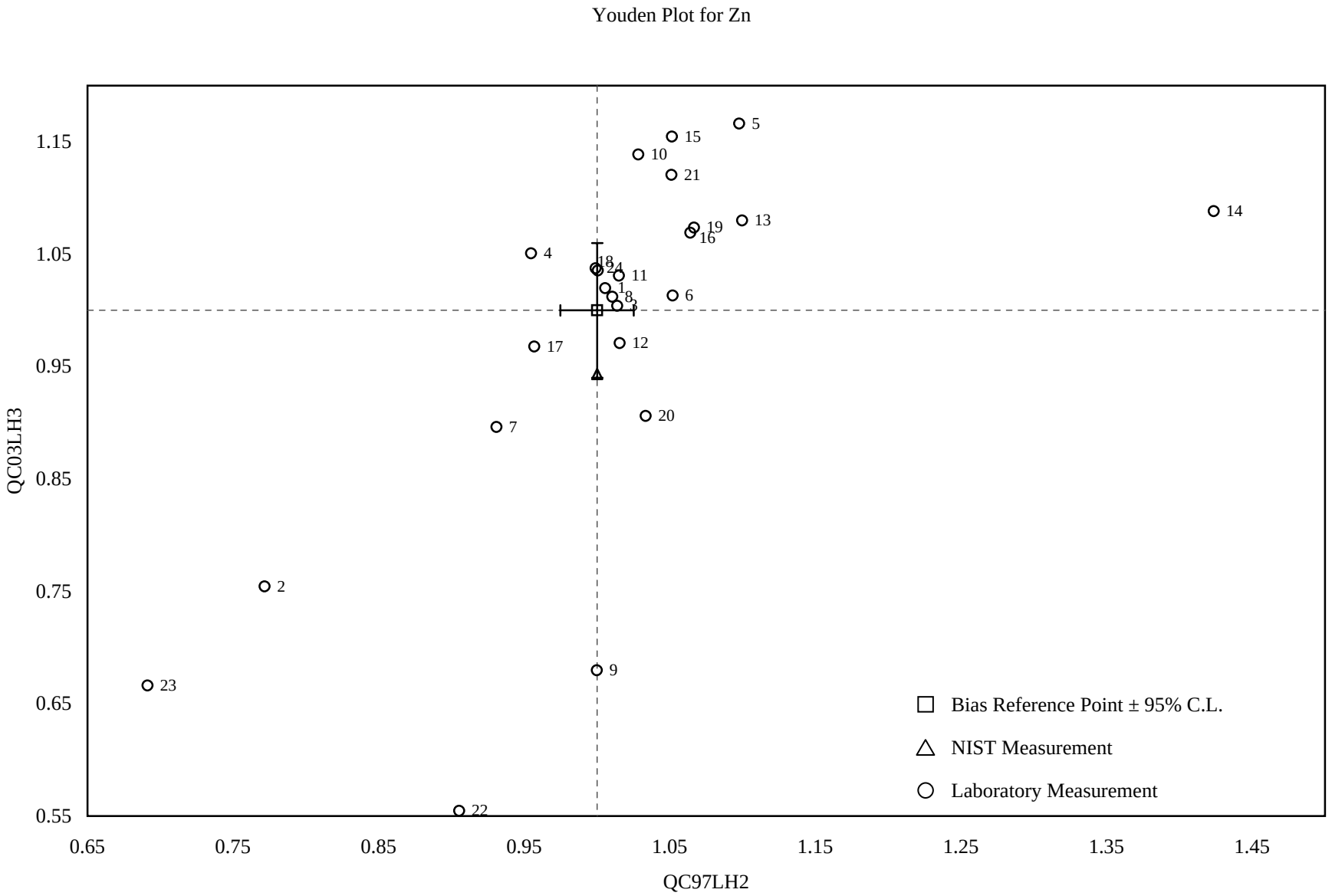
Youden Plot for Se



Youden Plot for Sn




Youden Plot for V
QC03LH3
QC97LH2
4
3.5
3
2.5
2
1.5
1
0.5
0
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
13
22
19
9
6
12
17
3
10
16
1
21
18
15
23
Bias Reference Point ± 95% C.L.
NIST Measurement
Laboratory Measurement


Youden Plot for Zn
QC03LH3
QC97LH2
1.15
1.05
0.95
0.85
0.75
0.65
0.55
0.65
0.75
0.85
0.95
1.05
1.15
1.25
1.35
1.45
5
15
10
21
14
19
13
16
4
18
24
11
1
8
3
6
17
12
20
7
2
9
23
22
Bias Reference Point ± 95% C.L.
NIST Measurement
Laboratory Measurement